



U.S. Department of Energy  
**Office of River Protection**

0060272

P.O. Box 450  
Richland, Washington 99352

03-ED-135

SEP 02 2003

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Air Emissions and Defense  
Waste Section  
State of Washington  
Department of Health  
P.O. Box 47827  
Olympia, Washington 98504

**RECEIVED**  
SEP 11 2003

**EDMC**

Dear Mr. Conklin:


TRANSMITTAL OF RADIOACTIVE NOTICE OF CONSTRUCTION (NOC) AS REQUIRED UNDER WASHINGTON ADMINISTRATIVE CODE 246-247 FOR INSTALLATION AND OPERATION OF A WASTE RETRIEVAL SYSTEM IN SINGLE-SHELL TANKS 241-C-201, 241-C-202, 241-C-203, AND 241-C-204

The U.S. Department of Energy (DOE), Office of River Protection requests the State of Washington Department of Health (WDOH) approval of the revised NOC Application for Retrieval of Waste from Series 241-C-200 Tanks (Attachment).

On July 8, 2003, WDOH approved the subject NOC in WDOH letter AIR 03-703. The DOE submitted the initial NOC before the project's conceptual engineering design had been completed. During the WDOH review of the NOC application, DOE made several changes to the project description. To expedite accelerated cleanup activities, WDOH allowed informal changes to be made to the application and provided its approval on July 8, 2003. This submittal is to make formal transmittal of the final project description as defined in AIR 03-703.

If you have any questions, please contact me, or your staff may contact Dennis W. Bowser, Environmental Division, (509) 373-2566, or Phil Miller, CH2M HILL Hanford Group, Inc., (509) 373-1920.

Sincerely,

  
Roy J. Schepens  
Manager

ED:DWB

Attachment

cc: See page 2

Mr. A. W. Conklin  
03-ED-135

-2-

SEP 02 2003

cc w/attach:

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B. Becker-Khaleel, Ecology  
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Administrative Record  
Environmental Portal, LMSI  
WDOH Richland Office

**Attachment  
03-ED-135**

**Notice of Construction Application for Retrieval of  
Waste From 241-C-200 Series Tanks**

# **NOTICE OF CONSTRUCTION APPLICATION FOR RETRIEVAL OF WASTE FROM 241-C-200 SERIES TANKS**

**C. J. Kemp**  
CH2M HILL Hanford Group, Inc.

**Date Published**  
August 2003



**CH2MHILL**  
*Hanford Group, Inc.*

Post Office Box 1500  
Richland, Washington

Prepared for the U.S. Department of Energy  
Office of River Protection

Contract No. DE-AC27-99RL14047

**Approved for Public Release; Further Dissemination Unlimited**

## CONTENTS

1.0	FACILITY NAME AND LOCATION	1
2.0	RESPONSIBLE MANAGER.....	3
3.0	PROPOSED ACTION.....	3
4.0	STATE ENVIRONMENTAL POLICY ACT OF 1971.....	5
6.0	EXISTING AND PROPOSED ABATEMENT TECHNOLOGY.....	6
7.0	APPLICABLE CONTROL TECHNOLOGY DRAWINGS.....	8
8.0	RADIONUCLIDES OF CONCERN – POTENTIAL EMISSIONS.....	10
9.0	EFFLUENT MONITORING SYSTEM FOR THE PROPOSED CONTROL SYSTEM.....	10
10.0	RADIONUCLIDE ANNUAL POSSESSION QUANTITY.....	11
11.0	PHYSICAL FORM OF EACH RADIONUCLIDE IN THE INVENTORY.....	12
12.0	RELEASE FORM OF EACH RADIONUCLIDE IN THE INVENTORY.....	12
13.0	RELEASE RATES.....	13
15.0	TOTAL EFFECTIVE DOSE EQUIVALENT TO THE MAXIMALLY EXPOSED INDIVIDUAL.....	15
16.0	COST FACTORS.....	18
17.0	FACILITY PROCESS ESTIMATED LIFETIME.....	18
18.0	CONTROL TECHNOLOGY STANDARDS.....	18
	REFERENCES.....	24

## **APPENDICES**

Appendix A Calculations for Pit Opening .....	26
Appendix B Calculations for Equipment Removal .....	28
Appendix C Calculations for Soil Excavation .....	36
Appendix D Calculations for Exhauster Operations .....	37
Appendix E ALARACT Agreements to be Used for C-200 Series Retrieval .....	46

## **FIGURES**

Figure 1. Hanford Site .....	2
Figure 2. Typical Ventilation System. ....	9

## **TABLES**

Table 1. Metric Conversion Chart. ....	iv
Table 2. Tank C-200 Series Inventory .....	11
Table 3. Total Effective Dose Equivalents to the MEI .....	16
Table 4. Breather Filter Standards Comparison .....	18

## TERMS

ALARACT	as low as reasonably achievable control technology
ANSI	American National Standards Institute
APQ	Annual Possession Quantity
ASME	American Society of Mechanical Engineers
BARCT	best available radionuclide control technology
CFR	Code of Federal Regulations
Ci	curie
HEPA	high-efficiency particulate air
MEI	maximally exposed individual
MPR	maximum public receptor
NOC	notice of construction
SEPA	<i>State Environmental Policy Act of 1971</i>
TEDE	total effective dose equivalent
WAC	<i>Washington Administrative Code</i>
WDOH	Washington State Department of Health

**Table 1. Metric Conversion Chart**

Into metric units			Out of metric units		
If you know	Multiply by	To get	If you know	Multiply by	To get
<b>Length</b>			<b>Length</b>		
inches	25.40	Millimeters	millimeters	0.0393	inches
inches	2.54	Centimeters	centimeters	0.393	inches
feet	0.3048	Meters	meters	3.2808	feet
yards	0.914	Meters	meters	1.09	yards
miles	1.609	Kilometers	kilometers	0.62	miles
<b>Area</b>			<b>Area</b>		
square inches	6.4516	square centimeters	square centimeters	0.155	square inches
square feet	0.092	square meters	square meters	10.7639	square feet
square yards	0.836	square meters	square meters	1.20	square yards
square miles	2.59	square kilometers	square kilometers	0.39	square miles
acres	0.404	Hectares	hectares	2.471	acres
<b>Mass (weight)</b>			<b>Mass (weight)</b>		
ounces	28.35	Grams	grams	0.0352	ounces
pounds	0.453	Kilograms	kilograms	2.2046	pounds
short ton	0.907	metric ton	metric ton	1.10	short ton
<b>Volume</b>			<b>Volume</b>		
fluid ounces	29.57	Milliliters	milliliters	0.03	fluid ounces
quarts	0.95	Liters	liters	1.057	quarts
gallons	3.79	Liters	liters	0.26	gallons
cubic feet	0.03	cubic meters	cubic meters	35.3147	cubic feet
cubic yards	0.76456	cubic meters	cubic meters	1.308	cubic yards
<b>Temperature</b>			<b>Temperature</b>		
Fahrenheit	subtract 32 then multiply by 5/9ths	Celsius	Celsius	multiply by 9/5ths, then add 32	Fahrenheit
<b>Force</b>			<b>Force</b>		
pounds per square inch	6.895	Kilopascals	kilopascals	$1.4504 \times 10^{-4}$	pounds per square inch

Source: *Engineering Unit Conversions*, M. R. Lindeburg, PE., Second Ed., 1990, Professional Publications, Inc., Belmont, California.

## INTRODUCTION

This document serves as a notice of construction (NOC) application, in accordance with 40 Code of Federal Regulations (CFR) 61.07 and Washington Administrative Code (WAC) 246-247-060, for the installation and operation of a waste retrieval system in Single-Shell Tank (SST) 241-C-201/202/203/and 204 tanks (241-C-200 Series Tanks). The 241-C-200 series tanks are four – 55,000-gallon capacity tanks constructed in 1946. The retrieval system for the 241-C-200 series tanks will utilize a pneumatic arm to “vacuum” waste sludges and interstitial liquids out of the tank and pump them using double contained over ground transfer lines to the Double Shell Tank system, or temporarily stage material in 241-C-104 (with approval from the Washington State Department of Ecology).

The total effective dose equivalent (TEDE) from all calendar year 2001 Hanford Site air emissions (point sources as well as diffuse and fugitive sources) was 0.49 millirem (DOE/RL-2002-20). The emissions resulting from the activities covered by this NOC application, in conjunction with other operations on the Hanford Site, will not exceed the National Emission Standard of 10 millirem per year (40 CFR 61, Subpart H). The conservative potential unabated emissions from all activities associated with the 241-C-201/202 tank retrievals project are estimated to result in an estimated TEDE to the hypothetical maximally exposed individual of approximately  $1.70\text{E}+00$  millirem per year to the onsite receptor, and 241-C-203/204 tank retrievals are  $4.67\text{E}-01$  millirem per year to the offsite receptor.

Abated emissions are estimated to result in a TEDE to the hypothetical offsite maximally exposed individual of  $4.14\text{E}-03$  millirem per year for retrieval of 241-C-203/204 tanks, and  $1.02\text{E}-02$  millirem per year for retrieval of 241-C-201/202 tanks. Activities that contribute to this dose include pit entries, equipment removal, excavation work, retrieval operations, and potential staging of waste at 241-C-104 single-shell tank. This dose estimate is conservative for purposes of bounding project activities. The duration of project activities is expected to be one year and the anticipated start of construction is June 2003.

This application also provides notification of anticipated initial start-up, in accordance with 40 CFR 61.09(a)(1). It is requested that approval of this application will also constitute Environmental Protection Agency (EPA) acceptance of the initial start-up notification. Written notification of the actual date of initial start-up, in accordance with 40 CFR 61.09(a)(2), will be provided at a later date.

## 1.0 FACILITY NAME AND LOCATION

*Regulatory Citation: "Name and address of the facility, location (latitude and longitude) of the emission unit(s)."*

The 241-C Tank Farm is located at the:

U.S. Department of Energy, Office of River Protection  
Hanford Site, 200 East Area Tank Farms  
Richland, Washington 99352

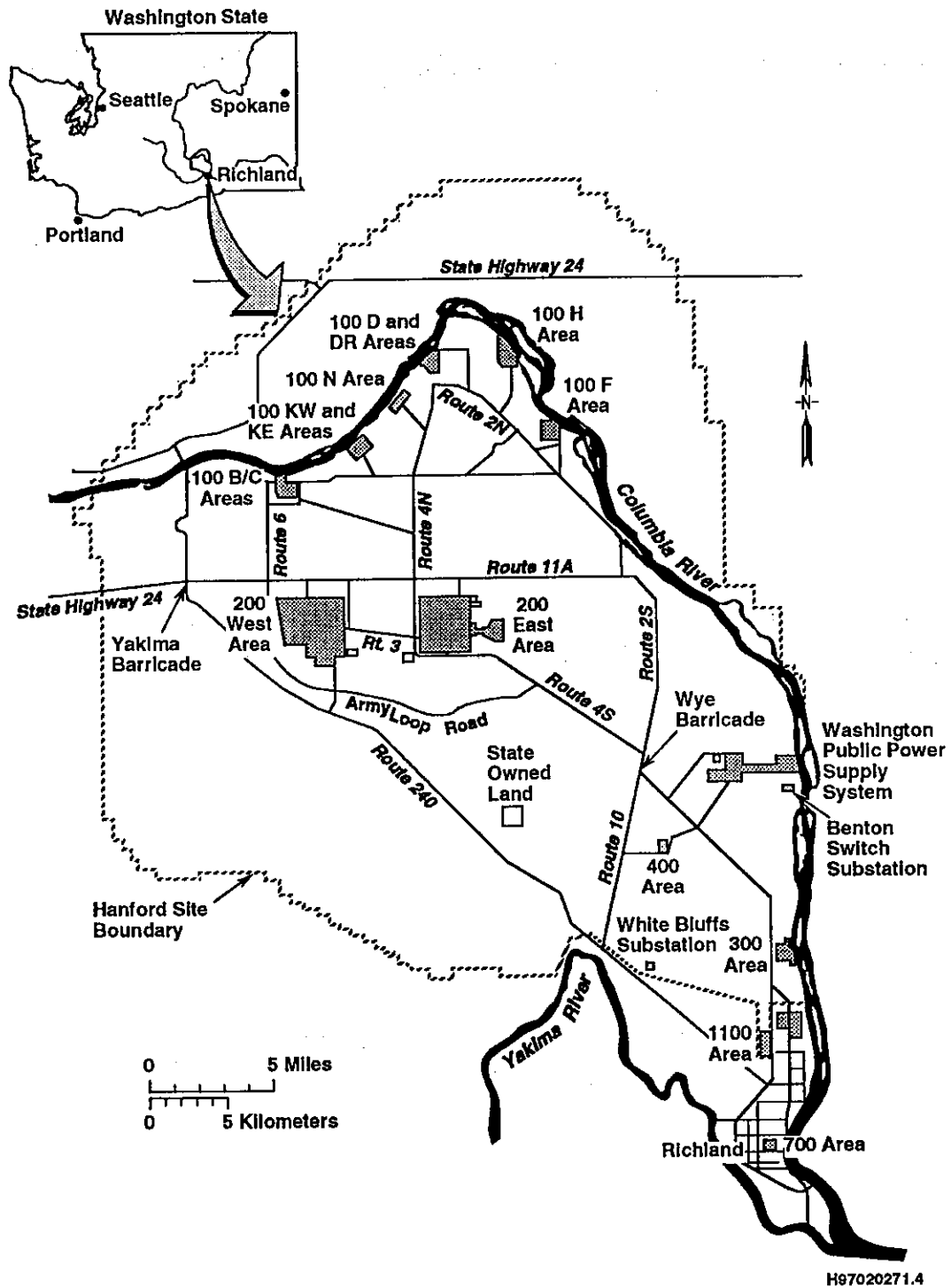
The C Tank Farm is due north of the PUREX Plant in the 200 East Area (see Figure 1) at the corner of Canton Avenue and Seventh Street. The proposed exhaustor is a saltwell exhaustor previously approved by WDOH for use on similar tank farm activities.

The Geodetic coordinates of 241-C tank farm is:

Latitude: 46° 33' 28.6"

Longitude: 119° 31' 5.8"

Figure 1. Hanford Site.



## 2.0 RESPONSIBLE MANAGER

*Regulatory Citation: "Name, title, address, and phone number of responsible manager."*

The responsible facility manager is:

Roy J. Schepens, Manager

U.S. Department of Energy, Office of River Protection

P.O. Box 450, MSIN H6-60

Richland, Washington 99352

(509) 376-6677

## 3.0 PROPOSED ACTION

*Regulatory Citation: "Identify the type of proposed action for which this application is submitted:*

- a. Construction of new emission unit(s);*
- b. Modification of existing emission unit(s); identify whether this is a significant modification – significant means the potential-to-emit airborne radioactivity at a rate that could increase the TEDE to the MEI by at least 1.0 mrem/yr as a result of the proposed modification;*  
*Modification of existing unit(s), unregistered."*

This application is submitted in accordance with WAC 246-247-060(1)(a) as a new Notice of Construction application for the retrieval of radioactive mixed wastes from Tank 241-C-200 series tanks at the Hanford Site in the State of Washington.

The proposed action will be to perform the following steps to retrieve or directly support the retrieval of wastes from the Tank 241-C-200 series. Where previously agreed upon controls identified in As Low As Reasonably Achievable Control Technology (ALARACT) demonstrations apply, the ALARACT number(s) are provided. The steps listed below may not necessarily be performed in this order:

### **Proposed Actions**

The proposed actions for tanks C-201, C-202, C-203, and C-204 will be to perform the following steps (not necessarily performed in this order) as required:

### Existing Equipment Removal

- Remove weather covers and remove debris from Jet Pump Pits and Ventilation Hatchways (using ALARACTs 1, 4, 6, 13, 14, and 15)
- Remove breather filters and reinstall with a "Y" configuration (tanks C-201 and C-202 only) (using ALARACT 16)
- Remove liquid level reels (using ALARACT 1, 4, 6, 13, 14, and 15)
- Remove thermocouple trees (using ALARACT 1, 4, 6, 13, 14, and 15)
- Remove liquid level reels (using ALARACT 1, 4, 6, 13, 14, and 15)
- Remove sluice eductor (using ALARACT 1, 4, 6, 13, 14, and 15)

- Remove sluice pump (tank C-204 only) (using ALARACT 1, 4, 6, 13, 14, and 15)

#### Individual Tank Equipment Installation

- Install articulated mast system (AMS) with connected hydraulic power pack, one per tank (using ALARACT 1, 4, 6, 13, and 14)
- Install ventilation inlet filter assembly, one per tank (using ALARACT 13 and 16)
- Install ventilation exhaust ducting (marries with single portable exhaust), one per tank (using ALARACT 6, 13 and 16)
- Install in-tank closed circuit television cameras, two per tank (using ALARACT 6, 13, and 16)
- Install master camera control system skid, one per tank, connecting to in-tank cameras (using ALARACT 6, 13, and 16)
- Install central VESSEL skid (with waste vessel), connecting individual AMS units via over ground transfer (OGT) lines (using ALARACT 1, 4, 6, 13 and 14)
- Install pump skid with connected hydraulic power pack (using ALARACT 1, 4, 6, 13 and 14)
- Install vacuum skid with connected hydraulic power pack (using ALARACT 1, 4, 6, 13 and 14)
- Install portable exhaust skid
- Install all support equipment for C-200 series retrieval including: instrumentation control room, install water distribution skid, install instrument electrical skid, diesel engine driven generator, air compressor
- Install OGT line from central VESSEL skid to pump skid (using ALARACT 1, 4, 6, 13 and 14)
- Install OGT line from pump skid to 241-AY-01A or 241-AY-02A pump pit (excavation for all OGT lines ~8500 ft<sup>3</sup>) using the "Guzzler" (using ALARACT 5)
- Run conduit and connect electrical lines for hydraulic power pack, VESSEL skid, pump skid, vacuum skid, portable exhaust, inlet filter, in-tank cameras, control instrumentation, generator, etc. (using ALARACT 5)
- Run hoses and connect air compressor, AMS, VESSEL skid, vacuum skid, etc. (if necessary using ALARACT 5)
- Run HVAC ducting from portable exhaust to mate with individual tank ventilation exhaust ducting (using ALARACT 1, 4, 6, 13 and 14)

#### Retrieval

- Retrieve wastes from C-201, C-202, C-203, and C-204 using the AMS to "vacuum" wastes to the central VESSEL skid
- Pump waste from central VESSEL skid to the Double Shell Tank System or "stage" waste in 241-C-104 using OGT lines (using ALARACT 11)
- Remove some or all of the in-tank and support equipment for maintenance, repair, disposal or re-use for future tank retrievals (using ALARACT 13, 14, 15, and 16)

Waste retrieval actions will be performed under active ventilation until structural safety considerations force shutdown of the exhaust at which time passive ventilation will be used. Staging of waste into 241-C-104 may, or may not, require active ventilation.

#### 4.0 STATE ENVIRONMENTAL POLICY ACT OF 1971

*Regulatory Citation: "If the project is subject to the requirements of the State Environmental Policy Act (SEPA) contained in Chapter 197-11 WAC, provide the name of the lead agency, lead agency contact person, and their phone number."*

The proposed action is categorically exempt from the requirements of the State Environmental Policy Act under WAC 197-11-845. The Tank Waste Retrieval System (TWRS) Environmental Impact Statement (EIS) bounds this retrieval project.

#### 5.0 CHEMICAL AND PHYSICAL PROCESSES

*Regulatory Citation: "Describe the chemical and physical processes upstream of the emission unit(s)."*

##### **Chemical and Physical Processes**

The 241-C 200 Series tanks, constructed during 1943 and 1944, originally received waste from B Plant and were sluiced out in the early 1950's, and then received pilot wastes for "Hot-Semi Works" and were again sluiced out in 1979. The four tanks are 20 feet in diameter and approximately 26 ft high, each with a 55-kgal capacity. Remaining waste left in these tanks range from 1000 gallons in 241-C-201/202 and 3000 gallons in 241-C-203/304.

During solids removal, waste will be removed via a vacuum system to a central holding vessel for transfer to the AY Tank Farm at a controlled rate. Solids will be removed to a total remaining waste volume of  $\leq 30 \text{ ft}^3$  of waste per tank (Hanford Federal Facility Agreement and Consent Order M-45-00 requirement).

The waste retrieval process to be used in the 241-C 200 Series tanks can be summarized as follows:

- Following installation of all in-tank equipment and above ground support equipment, the vacuum pumps in the vacuum skid will be started.
- The resulting vacuum will be directed through the AMS to the end effector unit, which is in contact with the tank waste.
- Due to the design of the end effector unit, the pneumatically assisted vacuum retrieval system will draw the waste up through the approximately three inch vacuum pipe to the waste vessel in the central end effector skid in batches up to an estimated 250 gallons.
- Varying amounts of air (up to 20 cfm) are introduced into the end effector unit to enhance waste removal and to reduce plugging of the vacuum pipe.
- The AMS is then valved out while the waste vessel is emptied and pumped out through the OGT line to the double shell tank system.
- When the waste vessel is nearly empty, the transfer line will then be valved out and the AMS will be valved back in and another batch of up to an estimated 250 gallons of waste will be removed from the tank.
- This process will be repeated until waste removal is complete.

- Once complete, valving between the end effector unit and the individual AMS units will be changed to allow waste retrieval from the next tank.

Waste retrieval actions will be performed under active ventilation until structural safety considerations force shutdown at which time HEPA filtered passive ventilation will be used.

For calculation purposes, this volume of the remaining sludge and interstitial liquids were used to estimate emissions based on the tank inventory reported in HNF-EP-0182, Revision 169, *Waste Tank Summary Report for Month Ending September 30, 2002*.

## 6.0 EXISTING AND PROPOSED ABATEMENT TECHNOLOGY

*Regulatory Citation: "Describe the existing and proposed (as applicable) abatement technology. Describe the basis for the use of the proposed system. Include expected efficiency of each control device, and the annual average volumetric flow rate(s) in meters<sup>3</sup>/sec for the emission unit(s)."*

During preparation and retrieval activities, controls will be established using the following ALARACT Demonstrations. ALARACT 1 "Demonstration for riser preparation/opening," ALARACT 4 "Demonstration for packaging and transportation of waste," ALARACT 5 "Demonstration for soil excavation (using hand tools)," ALARACT 6 "Demonstration for pit access," ALARACT 11, "Demonstration for waste transfers," ALARACT 13 "Demonstration for installation, operation, and removal of tank equipment", ALARACT 14 "Demonstration for pit work", ALARACT 15 "Demonstration for size reduction of waste equipment for disposal", and ALARACT 16 "Demonstration for work on potentially contaminated ventilation system components." Air, water, hydraulic, and electrical lines and a hose-in-hose transfer line, if necessary, may be placed in a shallow (~1 ft. trench) trench using ALARACT 5. See Attachment F for all ALARACT demonstrations that might be used to limit potential emissions during 241-C-200 series tank(s) waste retrieval activities. Excavations shall be performed using the "Guzzler" Notice of Construction AIR 98-1215 (*Use of the Guzzler Vacuum Excavation System for Radiologically Limited Activities on the Hanford Site*) and HEPA vacuum AIR 99-1103 (*HEPA Filtered Vacuum Radioactive Air Emission Units, Revision 1*).

Currently, Tank 241-C-200 series tanks are passively ventilated through a HEPA filter. The filter is a high-efficiency particulate air (HEPA) filter with a manufacturer rated removal efficiency of 99.97%. An active ventilation system will consist of a skid mounted HEPA filter (two stages) portable exhaustor (POR-003) referred to as 296-P-43 (or similar exhaustor). If the 241-C-104 tank is used to "stage" waste retrieved from the 241-C-200 series tanks then the 296-P-33 rotary mode core sampler exhaustor (or similar exhaustor) shall be used during waste transfers.

Due to operational considerations, this saltwell portable exhauster is preferred for the waste retrieval activity. The portable exhauster would run up to 0.47 m<sup>3</sup>/sec (~1000 cfm) and has a heater upstream of the HEPA filters. The portable exhauster will be designed to pass outside air through the tank and filter that air during exhauster operations before exiting to the atmosphere. The portable exhauster will have a heater, a pre-filter, and two stages of high-efficiency particulate air (HEPA) filters that filter air before release to the environment. The exhauster will not be operated at a flow that exceeds the HEPA filter rating in each stage. The abatement technology for the emission unit will undergo routine maintenance, repair, and replacement-in-kind as defined in WAC 246-247-030(22) and (23)(a) and (b) and includes the following:

- Glycol (or similar) heaters and associated components,
- One pre-filter and housing,
- Two HEPA filters and test sections,
- One exhaust fan,
- Stack containing a sampling system.

During exhauster operations, air from the tank will pass through the heater, a pre-filter, two HEPA filters in series, a fan, and discharged through a stack. The stack will contain a section that allows airflow measurements, radiological sample extraction, and potential vapor sampling activities. The pre-filter will increase the life of the HEPA filters by trapping the larger airborne particles to allow for a more economical operating system. As low as reasonably achievable (ALARA) concepts will be applied to allow for less frequent change out of the HEPA filters, thereby reducing exposure to personnel to radiological materials.

The HEPA filters will meet the requirements of ASME AG-1, Section FC and will be tested annually to requirements of ASME N510. The HEPA filters will be nuclear grade throwaway extended-media dry-type in a rigid case having minimum particle collection efficiency of 99.97 percent for 0.3-micrometer median diameter, thermally generated dioctylphthalate particles or other specified challenge aerosols. Pressure drop of a clean filter will be a maximum of one-inch water gauge at a rated flow. The frame will be corrosion resistant for the air stream design conditions. Each filter will have gelatinous or elastomer seal gasket material.

The HEPA filter housing will provide a sealed barrier for the confinement of airborne radionuclides and will serve to encapsulate and hold the HEPA filter. The filter housing will provide for the attachment of pressure differential measurement components. Each filter housing will meet the applicable sections of ASME N509 and the test requirements of ASME N510. The filter housings will be leak tested using the pressure decay method in accordance with ASME N510.

The test sections will provide a means for in place testing of the HEPA filters tested to 99.95 percent efficiency. Testing will confirm that any airborne radionuclide particles are captured to the level of efficiency of the installed HEPA filter. One test section will

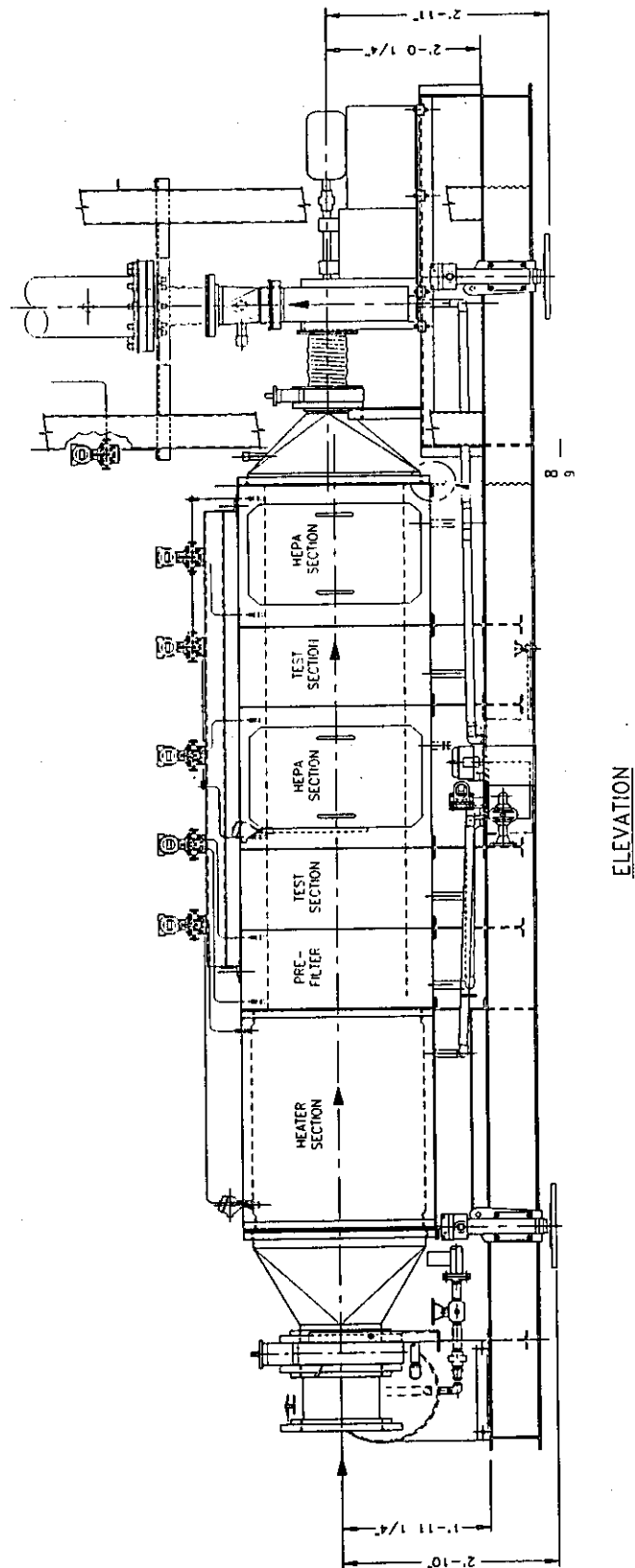
be placed downstream of the pre-filter section and upstream of the first HEPA filter section. The second test section will be placed between the first stage HEPA filter housing and the second stage HEPA filter housing.

Ductwork will be used to connect the exhaust inlet to the tank riser. Ductwork used will meet requirements of ASME AG-1, Section SA. The exhaust fan will be constructed of non-sparking materials and will meet Air Movement Contractors Association (AMCA) Standard 99-0401-86 and be Type A construction. The fan will be a centrifugal type and be statically and dynamically balanced as an assembly. The exhaust stack will house the air velocity probe and the air-sampling probe. Portable exhauster 296-P-43 (or equivalent) will be operated in accordance with the pre-operational testing per WAC 246-247-060 paragraph 4 and a notice of anticipated startup date will be provided in accordance with 40 CFR 62.09.

## **7.0 APPLICABLE CONTROL TECHNOLOGY DRAWINGS**

*Regulatory Citation: "Provide conceptual drawings showing all applicable control technology components from the point of entry of radionuclides into the vapor space to release to the environment." (See Figure 3.)*

Figure 2. Typical Ventilation System.



## 8.0 RADIONUCLIDES OF CONCERN – POTENTIAL EMISSIONS

*Regulatory Citation: "Identify each radionuclide that could contribute greater than ten percent of the potential-to-emit TEDE to the MEI, or greater than 0.1 mrem/yr potential-to-emit TEDE to the MEI."*

Radionuclides estimated to contribute greater than ten percent of the unabated potential-to-emit TEDE to the MEI from operation of the waste retrieval at the C-201/202 series tanks are assumed to be Sr-90, Cs-137, Pu-239, and Am-241. These are derived by direct application of the CAP-88PC dose conversion factors, discussed in Section 14.0, to the inventory values listed in Table 2 (after determining the release fraction). Continuous monitoring, as required by 40 CFR 61.93, will be performed during exhauster operations.

## 9.0 EFFLUENT MONITORING SYSTEM FOR THE PROPOSED CONTROL SYSTEM

*Regulatory Citation: "Describe the effluent monitoring system for the proposed control system. Describe each piece of monitoring equipment and its monitoring capability, including detection limits, for each radionuclide that could contribute greater than ten percent of the potential-to-emit TEDE to the MEI, or greater than 0.1 mrem/yr potential-to-emit TEDE to the MEI, or greater than twenty-five percent of the TEDE to the MEI, after controls. Describe the method with detail sufficient to demonstrate compliance with the applicable requirements."*

The active ventilation system will sample and monitor the ventilation emissions continuously. The system will collect its sample via a shrouded probe. The installation location, as well as the shrouded probe assembly and transport lines, has been qualified per the applicable requirements of ANSI/HPS N13.1-1999. This is documented in PNNL-11701, *Generic Effluent Monitoring System Certification for Salt Well Portable Exhauster*. Any operations conducted under passive ventilation will involve periodic confirmatory measurements taken of the breather filter exhaust.

Table 3 shows that Sr-90 contributes 32%, Cs-137 contributes 13%, Pu-239 contributes 31%, and Am-241 contributes 17% of the unabated TEDE to the MEI before emission controls for retrieval of C-203/204 and will require monitoring specifically in the record sampler. For C-201/202 the unabated contribution is 56% Pu-239 and 31% for Am-241 before emission controls.

A representative sample of gross alpha, gross beta, Sr-90, Cs-137, Pu-239, and Am-241 will be collected in the record sample collection system and analyzed by the laboratory. Results will be published in the annual Hanford Site Emission reports. The quality and detection limits of these analyses are controlled via the current revisions of the following documents:

- HNF-EP-0528, NESHAP Quality Assurance Project Plan for Radioactive Air Emissions

- HNF-EP-0835, Statement of Work for Services Provided by the Waste Sampling and Characterization Facility for the Environmental Compliance Program during Calendar Year 2002.
- RPP-QAPP-004, Quality Assurance Program Plan for Tank Farm Contractor Radioactive Air Emissions.

## 10.0 RADIONUCLIDE ANNUAL POSSESSION QUANTITY

*Regulatory Citation: "Indicate the annual possession quantity for each radionuclide."*

The annual possession quantity for Tank 241-C-200 Series Tanks are listed in Table 2. The inventory data source was:

- TWINS3, Best Basis/TCR, Tank Inventory taken on date 8/20/02. This data was dated within TWINS as 1/1/01.

Table 2. Tank C-200 Series Inventory.

Analyte	C-201 Ci	C-202 Ci	C-203 Ci	C-204 Ci
3H	9.80E-04	1.02E-03	1.95E-03	1.26E-03
14C	2.01E-03	2.09E-03	4.00E-03	2.58E-03
60Co	8.42E-04	8.77E-04	1.68E-03	1.08E-03
59Ni	7.52E-01	7.84E-01	1.50E+00	9.66E-01
63Ni	7.00E+01	7.29E+01	1.40E+02	8.99E+01
79Se	8.79E-04	9.16E-04	1.75E-03	1.13E-03
90Sr	4.13E+02	4.31E+02	8.23E+02	5.32E+02
90Y	4.13E+02	4.31E+02	8.23E+02	5.32E+02
93Zr	3.88E-02	4.04E-02	7.73E-02	4.98E-02
93mNb	3.45E-02	3.59E-02	6.88E-02	4.43E-02
99Tc	1.41E-02	1.47E-02	2.82E-02	1.81E-02
106Ru	1.36E-07	1.42E-07	2.71E-07	1.75E-07
113mCd	7.20E-02	7.50E-02	1.44E-01	9.24E-02
126Sn	5.61E-03	5.85E-03	1.12E-02	7.21E-03
125Sb	1.41E-03	1.47E-03	2.81E-03	1.81E-03
129I	2.74E-05	2.85E-05	5.46E-05	3.52E-05
134Cs	7.46E-07	7.78E-07	1.49E-06	9.59E-07
137Cs	7.87E+01	8.22E+01	1.57E+02	1.01E+02
137mBa	7.45E+01	7.77E+01	1.48E+02	9.59E+01
151Sm	3.12E+01	3.25E+01	6.22E+01	4.01E+01
152Eu	4.05E-01	4.22E-01	8.08E-01	5.20E-01
154Eu	1.91E-01	1.99E-01	3.80E-01	2.45E-01
155Eu	1.42E+01	1.48E+01	2.83E+01	1.82E+01
226Ra	6.52E-05	6.79E-05	1.30E-04	8.37E-05
228Ra	1.78E-10	1.85E-10	3.54E-10	2.28E-10
227Ac	2.56E-04	2.66E-04	5.10E-04	3.28E-04
229Th	6.63E-08	6.91E-08	1.32E-07	8.52E-08
232Th	4.78E-13	4.98E-13	9.54E-13	6.14E-13

231Pa	8.65E-06	9.01E-06	1.73E-05	1.11E-05
232U	4.15E-09	2.60E-08	8.27E-09	5.35E-09
233U	2.66E-10	7.31E-10	5.30E-10	3.42E-10
234U	3.75E-04	3.99E-04	7.47E-04	4.82E-04
235U	1.69E-05	1.68E-05	3.36E-05	2.17E-05
236U	2.39E-06	9.28E-06	4.77E-06	3.08E-06
238U	3.80E-04	3.96E-04	7.56E-04	4.89E-04
237Np	4.28E-05	4.46E-05	8.53E-05	5.49E-05
238Pu	1.45E+00	7.62E-01	3.81E-01	7.76E-03
239Pu	6.48E+01	3.39E+01	1.70E+01	3.47E-01
240Pu	1.07E+01	5.57E+00	2.79E+00	5.69E-02
241Pu	7.92E+01	4.14E+01	2.07E+01	4.23E-01
242Pu	5.46E-04	2.85E-04	1.43E-04	2.92E-06
241Am	2.27E+01	1.19E+01	5.95E+00	1.21E-01
243Am	5.26E-04	2.75E-04	1.37E-04	2.80E-06
242Cm	3.41E-02	1.78E-02	8.93E-03	1.81E-04
243Cm	1.63E-03	8.52E-04	4.26E-04	8.70E-06
244Cm	7.20E-04	3.76E-04	1.88E-04	3.84E-06

## 11.0 PHYSICAL FORM OF EACH RADIONUCLIDE IN THE INVENTORY

*Regulatory Citation: "Indicate the physical form of each radionuclide in inventory: Solid, particulate solids, liquid, or gas."*

Each radionuclide in the inventory listed in Table 2 is contained in the tank waste, which consists of gases, liquids, and solids. Excavation of soils and removal of particulate debris from pits are expected to be particulate solids.

## 12.0 RELEASE FORM OF EACH RADIONUCLIDE IN THE INVENTORY

*Regulatory Citation: "Indicate the release form of each radionuclide in inventory: Particulate solids, vapor, or gas. Give the chemical form and ICRP 30 solubility class, if known."*

The radionuclides in the inventory listed in Table 2 are assumed to be released as liquids or solids, except for H-3, C-14, Ru-106, and I-129, which will be released as a combination of liquids and gases.

### 13.0 RELEASE RATES

#### *Regulatory Citation:*

- "a. New emission unit(s): Give predicted release rates without any emission control equipment (the potential-to-emit) and with the proposed control equipment using the efficiencies described in subsection 6 of this section.*
- b. Modified emission unit(s): Give predicted release rates without any emissions control equipment (the potential-to-emit) and with the existing and proposed control equipment using the efficiencies described in subsection 6 of this section. Provide the latest year's emission data or emissions estimates."*

Abated emissions from passive and diffuse sources (including the 241-C-200 series tanks) were reported in DOE/RL-2002-20, *Radionuclide Air Emissions Report for the Hanford Site, Calendar Year 2001*. Abated emissions from all the Hanford Site sources were 0.49 mrem.

### 13.1 Pit Work

The Annual Possession Quantity (APQ) for the opening of the jet pump cover at 241-C-200 series is based on an estimate of smear data within other C-Farm pits. No historical smear data from the inside of the C-200 series pit covers were found during a history search. The data used was found to be accurate for radiological bounding data in RPP-12012. Contamination levels used for the calculation were  $1\text{E}+06$  dpm beta/gamma, and  $<1400$  dpm alpha. These values were used for the calculated emissions. The total surface area values were calculated for the pump pit (the total surface area was multiplied by 2X to take into account equipment in the pits and to accommodate for some variation in contamination levels) for a total of 16 openings. The APQ for this activity was calculated at  $4.08\text{E}-01$  Curies. Both the unabated and abated dose is calculated as  $5.22\text{E}-05$  mrem/year offsite. The calculations used are presented in Appendix A.

The APQ for the opening of the heel pit cover at the double shell tanks system (receiver tank for the retrieval from 241-C-200 series tanks) is based on historical smear data from the inside of the pit covers at 241-AY-101. For conservatism, the highest smear data was used for all six sides of the pit. The maximum removal contamination is expected to be below  $8.5\text{E}+05$  dpm beta/gamma and  $<20$  dpm alpha. These values were used for the calculated emissions when opening the heel pit at 241-AY-101. The total surface area value was calculated for the heel pit (the total surface area was multiplied by 2X to take into account equipment in the pit) for a total of four openings. The Annual Possession Quantity was calculated to be  $1.91\text{E}-02$  Curies. Both the unabated and abated dose is calculated as  $2.11\text{E}-06$  mrem/year offsite. The calculations used are presented in Appendix A.

### 13.2 Equipment Removal

The unabated emissions estimate for the removal of in tank equipment through the jet pump pit was determined by assuming a 0.16 centimeter (0.0625 inches) layer of the

241-C-200 series tank inventory being uniformly distributed across the surface area of the equipment removed from the 241-C-201/202/203/and 204 tanks. The calculation applies the 40 CFR 61 Appendix D release factor for particulates to the total volume contained over that surface area.

The equipment planned for removal includes removing liquid level reel (all tanks), thermocouple tree (tanks C-201, C-202 and C-203 only), sluice eductor (all tanks), and sluice pump (tank C-204 only). For the purposes of conservatism each calculation assumes removal of a liquid level reel in each tank thermocouple in each tank, two sluice eductors in each tank, and a sluice pump in 241-C-204 tank only will all be removed in the calculations. The Annual Possession Quantity was calculated to be  $2.24\text{E}+01$  Curies. Both the calculated offsite unabated and abated emissions are  $9.37\text{E}-03$  for C-201/202 and  $9.65\text{E}-04$  for C-203/204 tanks. The potential unabated emissions from in-tank equipment removals are shown in appendix B and include calculated emissions for one additional piece of large in tank equipment, as a contingency.

### 13.3 Soil Excavation

The calculation assumes a maximum of  $1\text{E}+06$  dpm beta and  $<1400$  dpm alpha. The beta-gamma contributing radionuclide was assumed to be Sr-90 and the alpha contributing radionuclide was assumed to be Am-241 to be conservative. These values were multiplied with the appropriate dose conversion factors and the maximum volume of soil to be excavated. The average soil density was assumed to be  $1590\text{ kg/m}^3$  ( $98\text{ lbs/ft}^3$ ). A total of  $8500\text{ ft}^3$  of contaminated soil was calculated to be excavated within C-Farm, AY-Farm, and from C-Farm to the AY-Farm (if soil contamination is detected). The APQ from soil excavation activities was calculated at  $1.35\text{E}+01$  Curies. Both the abated and unabated dose for soil excavation is  $5.74\text{E}-03$  mrem/year offsite. A conservatism factor of 2X was applied. Calculations are in Appendix C.

<sup>3</sup> No new riser constructions are planned.

<sup>4</sup> Assume all excavations will be performed using the vacuum excavation truck (a.k.a. "the Guzzler").

### 13.4 Retrieval

The APQ and release rates for the tank are based upon using a release fraction of 1 for gases,  $10^{-3}$  for liquids and solids per 40 CFR 61, Appendix D. The 241-C-201 and 241-C-202 tank contains 1,000 gallons of sludge each, the 241-C-203 and 241-C-204 tanks contain 3000 gallons of sludge each (HNF-EP-0182-174). The releases were calculated to be continuous. The calculations performed are presented in Appendix D.

For retrieval of 8,000 gallons of solids (gases are expected to all be released during retrieval) and placement into the receiver tank, the total APQ was conservatively calculated to be  $6.16\text{E}+03$  Curies. The unabated emissions for C-201/202 were calculated to be  $1.70\text{E}+00$  mrem/yr and abated emissions would be  $8.53\text{E}-03$  mrem/yr to the onsite receptor. The unabated emissions for C-203/204 were calculated to be  $4.62\text{E}-01$  mrem/yr and abated emissions would be  $2.62\text{E}-04$  mrem/yr to the offsite receptor.

Abated emissions for active ventilation were determined by dividing the unabated results by 2000, the usual HEPA filter decontamination factor, which represents an in-place tested particulate removal efficiency of 99.95% for particulate. No decontamination factor was used for H-3, C-14, I-129, and Ru-106. For these radionuclides, the unabated emissions equal the abated emissions (based on the assumption that the HEPA filters are not designed to control this type of emission).

The total waste from all the 241-C-200 series tanks is 8000 gallons of sludge. The retrieval has conservatively calculated a complete retrieval (100% removal) using a vacuum like system, that will incorporate a  $10^{-3}$  release fraction for particulates (using a R.F. of 1 for gases) per 40 CFR 61 appendix D.

#### **14.0 DISTANCES AND DIRECTION OF THE MAXIMALLY EXPOSED INDIVIDUAL**

*Regulatory Citation: "Identify the MEI by distances and direction from the emission unit(s). The MEI is determined by considering distance, windrose data, presence of vegetable gardens, and meat or milk producing animals at unrestricted areas surrounding the emission unit."*

The MEI is determined using CAP-88 dispersion factors, which are derived for use on the Hanford Site and published in HNF-3602, Revision 1, *Calculating Potential-to-Emit Releases and Doses for FEMPs and NOCs*. Values used for the 241-C-200 series tanks were taken from Table 4-9, for 200 E Area with effective release height < 40 m. Unit dose factors from both the On Site maximum public receptor (MPR) and Off Site MPR were examined.

The On Site MPR Unit Dose factors were used for 241-C-201 and 241-C-202 retrieval to perform the final calculations as they were determined to return the highest (conservative) values. In this case, according to HNF-3602, Table 4-2, the MEI is 16,630 meters East-Southeast.

The Off Site MPR Unit Dose factors were used for 241-203 and 241-C-204 retrieval, all pit openings, and soil excavation as they were determined to return the highest (conservative) values. In this case, according to HNF-3602, Table 4-2, the MEI is 20,200 meters in the East-Southeast direction.

#### **15.0 TOTAL EFFECTIVE DOSE EQUIVALENT TO THE MAXIMALLY EXPOSED INDIVIDUAL**

*Regulatory Citation: "Calculate the TEDE to the MEI using an approved procedure (see WAC 246-247-085). For each radionuclide identified in subsection 8 of this section, determine the TEDE to the MEI for existing and proposed emission controls, and without any emission controls (the potential-to-emit) using release rates from subsection 13 of this section. Provide all input data used in the calculations."*

The doses discussed in Sections 13.1 through 13.4 were added together to determine the Total Effective Dose Equivalent (TEDE) to the Maximally Exposed Individual (MEI). The TEDE to the MEI is calculated to be 4.65E-01 mrem/yr (unabated) and 4.52E-03 mrem/yr (abated) for 241-C-203 and -204. The TEDE to the MEI is calculated to be 1.71E+00 mrem/yr (unabated) and 1.02E-02 mrem/yr (abated) for 241-C-201 and C-202, pit openings, and soil excavation.

**Table 3. Total Effective Dose Equivalent to the MEI**

Summary of Dose for C-201/202/203/204 Tanks

Retrieval & Equipment Removal

C-203 and C-204 offsite receptor

C-201 and C-202 onsite receptor

	Offsite Unabated Dose mrem/yr	Offsite Abated Dose mrem/yr	Contribution to Unabated Dose %	Contribution to Abated Dose %	Onsite Unabated Dose mrem/yr	Onsite Abated Dose mrem/yr	Contribution to Unabated Dose %	Contribution to Abated Dose %
		C=B/2000 (decon factor) except for gases, pit openings, soil excavation	D=B/Sum of B	E=C/Sum of C		G=F/2000 (decon factor) except for gases, pit openings, soil excavation	D=B/Sum of B	E=C/Sum of C
3H	8.04E-08	8.04E-08	0.00%	0.00%	1.43E-08	1.43E-08	0.00%	0.00%
14C	1.25E-05	1.25E-05	0.00%	0.30%	7.42E-07	7.42E-07	0.00%	0.01%
60Co	6.92E-07	1.97E-09	0.00%	0.00%	5.19E-07	3.10E-09	0.00%	0.00%
59Ni	7.66E-07	2.18E-09	0.00%	0.00%	4.48E-07	2.67E-09	0.00%	0.00%
63Ni	5.99E-05	1.70E-07	0.01%	0.00%	9.91E-06	5.92E-08	0.00%	0.00%
79Se	3.75E-07	1.07E-09	0.00%	0.00%	2.71E-07	1.62E-09	0.00%	0.00%
90Sr	1.51E-01	1.94E-03	32.35%	46.94%	8.06E-03	4.81E-05	0.47%	0.47%
90Y	4.62E-04	1.31E-06	0.10%	0.03%	2.21E-04	1.32E-06	0.01%	0.01%
93Zr	1.66E-07	4.71E-10	0.00%	0.00%	1.04E-07	6.18E-10	0.00%	0.00%
93mNb	2.38E-07	6.77E-10	0.00%	0.00%	8.49E-08	5.07E-10	0.00%	0.00%
99Tc	1.07E-06	3.03E-09	0.00%	0.00%	4.05E-08	2.42E-10	0.00%	0.00%
106Ru	8.94E-09	8.94E-09	0.00%	0.00%	5.31E-09	5.31E-09	0.00%	0.00%
113mCd	3.08E-05	8.75E-08	0.01%	0.00%	2.22E-05	1.32E-07	0.00%	0.00%
126Sn	8.67E-07	2.47E-09	0.00%	0.00%	4.72E-07	2.82E-09	0.00%	0.00%
125Sb	1.20E-07	3.42E-10	0.00%	0.00%	9.56E-08	5.71E-10	0.00%	0.00%
129I	1.80E-05	1.80E-05	0.00%	0.43%	1.24E-06	1.24E-06	0.00%	0.01%
134Cs	2.45E-10	6.98E-13	0.00%	0.00%	7.20E-11	4.30E-13	0.00%	0.00%
137Cs	6.21E-02	1.76E-04	13.30%	4.26%	4.37E-02	2.61E-04	2.55%	2.55%
137mBa	1.30E-13	3.69E-16	0.00%	0.00%	1.53E-12	9.14E-15	0.00%	0.00%
151Sm	7.69E-05	2.19E-07	0.02%	0.01%	5.38E-05	3.21E-07	0.00%	0.00%
152Eu	3.19E-04	9.08E-07	0.07%	0.02%	2.58E-04	1.54E-06	0.02%	0.02%
154Eu	1.25E-04	3.56E-07	0.03%	0.01%	9.80E-05	5.85E-07	0.01%	0.01%
155Eu	3.73E-04	1.06E-06	0.08%	0.03%	2.86E-04	1.71E-06	0.02%	0.02%
226Ra	9.85E-08	2.80E-10	0.00%	0.00%	3.35E-08	2.00E-10	0.00%	0.00%
228Ra	1.11E-13	3.15E-16	0.00%	0.00%	2.55E-14	1.53E-16	0.00%	0.00%

227Ac	1.26E-05	3.58E-08	0.00%	0.00%	9.45E-06	5.64E-08	0.00%	0.00%
229Th	3.48E-09	9.91E-12	0.00%	0.00%	2.72E-09	1.63E-11	0.00%	0.00%
232Th	1.45E-14	4.11E-17	0.00%	0.00%	1.18E-14	7.03E-17	0.00%	0.00%
231Pa	3.42E-07	9.71E-10	0.00%	0.00%	2.49E-07	1.48E-09	0.00%	0.00%
232U	1.50E-10	4.27E-13	0.00%	0.00%	3.94E-10	2.35E-12	0.00%	0.00%
233U	2.71E-12	7.71E-15	0.00%	0.00%	3.71E-12	2.21E-14	0.00%	0.00%
234U	3.82E-06	1.09E-08	0.00%	0.00%	2.88E-06	1.72E-08	0.00%	0.00%
235U	1.66E-07	4.73E-10	0.00%	0.00%	1.19E-07	7.08E-10	0.00%	0.00%
236U	2.28E-08	6.49E-11	0.00%	0.00%	4.11E-08	2.45E-10	0.00%	0.00%
238U	3.49E-06	9.94E-09	0.00%	0.00%	2.57E-06	1.54E-08	0.00%	0.00%
237Np	1.69E-06	4.79E-09	0.00%	0.00%	1.23E-06	7.35E-09	0.00%	0.00%
238Pu	2.96E-03	6.98E-06	0.63%	0.17%	1.98E-02	1.18E-04	1.16%	1.16%
239Pu	1.43E-01	3.36E-04	30.54%	8.11%	9.43E-01	5.63E-03	55.11%	55.10%
240Pu	2.34E-02	5.51E-05	5.01%	1.33%	1.55E-01	9.28E-04	9.08%	9.08%
241Pu	2.75E-03	6.48E-06	0.59%	0.16%	1.82E-02	1.09E-04	1.06%	1.06%
242Pu	1.14E-06	2.69E-09	0.00%	0.00%	7.60E-06	4.54E-08	0.00%	0.00%
241Am	8.05E-02	1.58E-03	17.25%	38.19%	5.22E-01	3.12E-03	30.50%	30.50%
243Am	1.82E-06	4.29E-09	0.00%	0.00%	1.21E-05	7.21E-08	0.00%	0.00%
242Cm	3.74E-06	8.82E-09	0.00%	0.00%	2.61E-05	1.56E-07	0.00%	0.00%
243Cm	3.70E-06	8.72E-09	0.00%	0.00%	2.50E-05	1.49E-07	0.00%	0.00%
244Cm	1.29E-06	3.03E-09	0.00%	0.00%	8.82E-06	5.26E-08	0.00%	0.00%

Total for  
C-200  
series  
retrieval +  
activities

4.67E-01 4.14E-03 100.00% 100.00% 1.71E+00 1.02E-02 100.00% 100.00%

Both abated and unabated doses include the unabated dose (no filtration) from  
the pit opening activities, equipment removal, and soil excavation activities

## 16.0 COST FACTORS

*Regulatory Citation: "Provide cost factors for construction, operating, and maintenance of the proposed control technology components and system, if a BARCT or ALARACT demonstration is not submitted with the NOC."*

Pursuant to WAC 246-247-110, App. A (16), cost factors for construction, operation, and maintenance of proposed technology requirements are not required, as the Washington State Department of Health (WDOH) has provided guidance that HEPA filters are generally considered best available radionuclide control technology (BARCT) for particulate emissions, AIR 92-107. Because the key radionuclides of concern are particulates, it is proposed that the HEPA filter controls described in Section 6.0 be accepted as BARCT. Compliance with the substantive BARCT technology standards is described in Section 18.0.

## 17.0 FACILITY PROCESS ESTIMATED LIFETIME

*Regulatory Citation: "Provide an estimate of the lifetime for the facility process with the emission rates provided in this application."*

Field activities to support equipment removal and installation are currently scheduled to begin June 2003. Waste removal activities are currently scheduled to start December 2003 and be completed no later than December 2004. Closure activities for 241-C-200 series tanks could begin following the completion of retrieval activities, but would require a revision to this NOC or inclusion of 241-C-200 series tanks into a categorical NOC addressing closure for multiple tanks.

## 18.0 CONTROL TECHNOLOGY STANDARDS

*Regulatory Citation: "Indicate which of the following control technology standards have been considered and will be complied with in the design and operation of the emission unit(s) described in this application: . . ."*

*ASME/ANSI AG-1, ASME/ANSI N509, ASME/ANSI N510, ANSI/ASME NQA-1, 40 CFR 60, Appendix A Methods 1, 1A, 2, 2A, 2C, 2D, 4, 5, and 17, and ANSI N13.1*

The ventilation system has been designed to meet the required WAC-246-247-110 control technology standards as described in the following table.

Table 4. Breather Filter Standards Comparison.

Standard	Does design comply?	Notes
ASME/ANSI AG-1	Yes	HEPA filter housing design meets ASME AG-1.
ASME/ANSI N509	Yes	HEPA filters on the Hanford Site are purchased following a site standard specification that

		lists requirements from AG-1. Also the filter housings are purchased to meet requirements in AG-1 for single filter, side access housings.
ASME/ANSI N510	Yes	Filters are testable per ANSI N510 and the housing will contain testing devices that meet requirements under AG-1.
ANSI/ASME NQA-1	Yes	Current version of QA program is performed in accordance with TFC-PLN-02, "Quality Assurance Program Description".
ANSI N13.1	NA	Confirmatory measurements will consist of smears on the filter.
40 CFR 60, Appendix A Test Methods: 1, 1A, 2, 2A, 2C, 2D, 4	NA	ASME N510 filter testing requires airflow measurements. Other methods not required because flow rates vary based upon barometric breathing.
40 CFR 60, Appendix A Test Methods: 5, 17	NA	These methods are for sampling system designs. Periodic confirmatory measurements will be taken via smears in lieu of a sampling system.

### PORTABLE EXHAUSTER (POR-03)

#### ASME/ANSI AG-1

American Society for Engineers (ASME)/American National Standards Institute (ANSI) AG-1: This equipment specific code consists of several primary sections, which are applicable to this unit. The applicable sections are fans (Section BA), ductwork (Section SA), HEPA filter housing (Section HA), HEPA filters (Section FC), dampers (Section DA), heaters (Section CA), moisture separators (Section FA), Field Testing of Air Treatment Systems (Section TA), and Quality Assurance (QA) (Section AA).

The fan section of AG-1 (Section BA) covers the construction and testing requirements for fans. This fan meets the applicable criteria identified in AG-1, except as identified below. It was constructed to the Air Movement and Control Association (AMCA) 99-401, "Spark Resistant Construction," criteria, and was tested to the applicable sections of AMCA 210. However, it cannot be shown the shaft leakage criteria are met (Section BA 4142.2). This is acceptable because a "stuffing box" is installed around the shaft to minimize the leakage, and the leakage point is located after the HEPA filters.

The next applicable requirement is the ductwork section of AG-1 (Section SA). As was the case for the fan, this section identifies several requirements for ductwork. This includes acceptable material, fabrication, and testing criteria. The ductwork used to connect the exhauster and the exhauster ductwork itself will be a combination of both metal and flexible polymer. In both cases it does meet the applicable criteria and will be pressure tested per the applicable criteria identified in AG-1 and N510 prior to operation.

The HEPA filter housing section (Section HA) was recently released and this section has taken the place of the requirements identified in N509. After reviewing the requirements identified in Section HA against the portable exhauster design, the portable exhauster filter housings are in compliance.

The HEPA filter section of AG-1 (Section FC) is also applicable in this instance. The filters, which will be installed in the exhauster, will meet the applicable sections of AG-1, except for two areas dealing with filter qualification testing. Justification for this exception was discussed with and approved by WDOH at the December, 1998 Routine Technical Assistance Meeting.

The dampers installed on the portable exhauster do meet the applicable AG-1, section DA. This includes design, construction and testing. The manufacturer performed a leak test on the valves, and a pressure decay test was also completed on the exhaust train system. For the pressure decay test, the valves were used for isolation. The test was successful.

The heater installed in the portable exhauster meets the requirements of AG-1, Section CA. The heater relies on a glycol mixture that is heated by a separate heating unit, similar to a hot water tank. The heated glycol is then pumped through the heating coil located inside the exhaust system. This type of design allows the system to be used in a flammable gas environment. By using a glycol heater, there are no electrical, sparking or energized components in contact with the air stream. In addition, controls are in place to prevent the damage of the HEPA filters if the coil were to fail. This includes level detection in the glycol reservoir, which will detect the loss of glycol. Differential pressure across the first HEPA filter is monitored. If the coil were to break, the differential pressure across the first HEPA would increase and the system would be shutdown.

The quality assurance section of AG-1 relies on ASME NQA-1. The general QA criteria are located in Section AA. Specific component/system criteria are located in each section throughout AG-1. The portable exhaustor was built on the Hanford Site and meets the site's QA program. This includes procurement of the safety material/components, along with appropriate pedigree from an evaluated supplier, tracking and maintaining the material/components after it arrived on site, inspection of the material/components, and witnessing the testing. Based on the above, these components meet the AG-1 criteria.

It could not be shown that the welds were inspected per the AG-1 Section FA requirements. Again, this is considered acceptable based on testing that was performed at the facility. Furthermore, the pad is not relied upon for particulate removal, but rather removal of entrained moisture. Therefore, if any defects exist in the welds, such as a leak path, this is not a significant issue because this would still provide a tortuous path for the air stream. As for structural strength of the weld, the system is not relied upon to survive an earthquake, nor relied upon to remove radioactive particulate. Therefore, if the welds fail it would not result in a release of contamination.

Based on the analysis presented above for AG-1 Section FA, it is proposed that the changes noted above be found acceptable.

#### ASME N509

This standard deals with the individual components and how they relate to the overall system. The major sections of ASME/ANSI N509 have been replaced with those identified in AG-1. There are certain sections that are still applicable, such as Section 4.3, which discusses the maximum flow rate for the system not to exceed the lowest maximum rating of any component installed in the system. This is being met, along with the other applicable sections of N509.

#### ASME N510

This standard pertains to the testing of nuclear air cleaning systems. The first requirement identified in ASME/ANSI N510 is to perform a pressure decay test. This is to assure there are no infiltration or outward leak paths from the system. This test was completed on the portable exhaustor and was successful.

This system meets the leak test criteria identified per N510. Test sections are located in the exhaust train to allow for proper independent testing of both HEPA filters.

#### Quality Assurance

The required technology standard is ANSI/ASME NQA-1, "Quality Assurance Program requirements for Nuclear Facilities." Quality Assurance for the ventilation system has been performed in accordance with TFC-PLN-02, "Quality Assurance Program Description."

## Stack Volumetric Flow Rate Determination Methods

Stack effluent flow rates are necessary to compile emissions and complete the required annual reports. Requirements for flow rates can be broken into three areas of discussion:

1. **Measurements Location:** The regulatory methods that specify the measurement location, distances from flow disturbances, number of measurements to take, etc. are provided in the following two methods:

- 40 CFR 60, Appendix A, Methods 1 – Sample and Velocity Traverses for Stationary Sources.
- 40 CFR 60, Appendix A, Methods 1A - Sample and Velocity Traverses for Stationary Sources with Small Stacks or Ducts.

The difference in these two methods is that one is for stacks 12 inches in diameter and larger, and the other is for under 12 inches. The exhauster stack is smaller than 12 inches. Therefore, Method 1A is followed for this exhauster.

2. **Measurement Method:** The regulatory method that specify the measurement method and instrumentation to use are as follows:

- 40 CFR 60, Appendix A, Methods 2 – Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Picot Tube).
- 40 CFR 60, Appendix A, Methods 2A – Direct Measurement of Gas Volume Through Pipes and Small Ducts.
- 40 CFR 60, Appendix A, Methods 2C – Determination of Gas Velocity and Volumetric Flow Rate in Small Stacks or Ducts (Standard Picot Tube). This method is applicable for the determination of average velocity and volumetric flow rate of gas streams in small stacks or ducts.
- 40 CFR 60, Appendix A, Methods 2D – Measurement of Gas Volume Flow Rates in Small Pipes and Ducts.

Either Method 2 or Method 2C are used in Tank Farms. The primary difference between Method 2 and 2C lies in the fact that Method 2 is applicable for stacks larger than 12 inches in diameter, while 2C applies to stack smaller than 12 inches. Method 2C is followed for this exhauster.

3. **Measurement Result:** Flow rates are to be reported in dry standard units of temperature and pressure. This means that the moisture content of the air stream must be taken into account when finalizing the flow rate values. Method 2 and Method 2C (through reference to Method 2) call the following method for this determination:

- 40 CFR 60, Appendix A, Methods 4 – Determination of Moisture Content in Stack Gases. This method is applicable to determination of moisture content in stack gas. This method is called out for use in Method 2 and 2C (through call out of Method 2). Method 2 requires that flow rates be converted to dry standard units.

A humidity probe is used to determine moisture content of the stream. The humidity value determined from this instrument is mathematically incorporated into the final flow rate measurement.

In addition to the methods just discussed; 40 CFR 52, Appendix E – Performance Specifications and, Specification Test Procedures for Monitoring Systems for Effluent Stream Gas Volumetric Flow Rate – is also used. The methods discussed above are for manual measurements. The Appendix E method allows for the installation and operation of instrumentation to automatically and continuously takes flow rate measurements. The Appendix E method requires use of Method 2 for use in comparison of the instrumentation readings and if after a series of measurements are taken the instrument accuracy is determined to be within that specified by the Appendix E method, the instrumentation is considered acceptable and can be used for flow rate determination and emission reporting purposes. The exhauster has been tested to Appendix E.

#### Sampling System Design Methods and Standards

Methods and Standards called out for sampling system design are as follows:

- 40 CFR 60, Appendix A, Methods 5 – Determination of Particulate Matter Emissions from Stationary Sources. This method is applicable for the determination of particulate emissions. This method details the sample probe, collection filter and holder, the vacuum system and instrumentation that might be used in the design of a particulate sample collection system.
- 40 CFR 60, Appendix A, “Methods 17 – Determination of Particulate Matter Emissions from Stationary Sources.” This method is applicable for determination of particulate matter (PM) emissions, where PM concentrations are known to be independent of temperature over the normal range of temperatures characteristic of emissions from a specified source category. It is intended for use only when specified by an applicable subpart of the standards, and only within the applicable temperature limits (if specified), or when otherwise approved by the Administrator. There are other provisions for use of this method. This method details the sample probe, collection filter and holder, the vacuum system and instrumentation that might be used in the design of a particulate sample collection system.
- ANSI N13.1-1969, Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities.
- ANSI/HPS N13.1-1999, sampling and Monitoring Releases of Airborne Radioactive Substances from Stacks and Ducts of Nuclear Facilities:

No attempts have been made to design the sampling and monitoring system to Methods 5 and 17. Instead, the system has been designed to meet the intent of ANSI/HPS N13.1-1999. A shrouded probe assembly is installed. The installation location, as well as the shrouded probe assemble, to include transport lines, has been qualified per the applicable requirements of ANSI/HPS N13.1-1999. This is documented in PNNL-11701, *Generic Effluent Monitoring System Certification for Salt Well Portable Exhauster*.

## REFERENCES

- 40 CFR 60, "Standards for Performance of New Stationary Sources," *Code of Federal Regulations*, as amended.
- 40 CFR 61, "National Emission Standards for Hazardous Air Pollutant." *Code of Federal Regulations*, as amended.
- AMCA Standard 99-0401-86, Air Movement Contractors Association, Chicago, Illinois
- ANSI/ASME AG-1, 1997, *Code on Nuclear Air and Gas Treatment*, American Society of Mechanical Engineers, New York, New York.
- ANSI/ASME NQA-1, *Quality Assurance program Requirements for Nuclear Facilities*, American Society of Mechanical Engineers, New York, New York.
- ANSI/HPS N13.1, 1999, *Sampling and Monitoring Releases of Airborne Radioactive Substances from Stacks and Ducts of Nuclear Facilities*, American National Standards Institute, New York, New York.
- ANSI N13.1, 1969, *Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities*, American National Standards Institute, New York, New York.
- ANSI N509, *Nuclear Power Plant Air Cleaning Units and Components*, American National Standards Institute, New York, New York.
- ANSI N510, *Testing of Nuclear Air Treatment Systems*, American National Standards Institute, New York, New York.
- DOE-HDBK-3010-94 Change Notice No. 1, March 2000, *Airborne Release Fractions/Rates and Respirable Fractions for NonReactor Nuclear Facilities*,
- DOE/RL-2002-20, *Radionuclide Air Emissions Report for the Hanford Site, Calendar Year 2001*, U.S. Department of Energy Richland Operations Office, Richland, Washington.
- Hanford Federal Facility Agreement and Consent Order by Washington State Department of Ecology, United States Environmental Protection Agency, and United States Department of Energy.
- HNF-EP-0182-174, *Waste Tank Summary Report for Month Ending, September 30, 2002*, CH2MHILL Hanford Group, Inc., Richland, Washington.
- HNF-SD-WM-TI-797, 1998, *Results of Vapor Space Monitoring of Flammable Gas Watch List Tanks*, Rev. 3, Lockheed Martin Hanford Company and DE&S Hanford, Inc., Richland, Washington.
- HNF-0528, Revision 4, *National Emission Standards for Hazardous Air Pollutants (NESHAP) Quality Assurance Project Plan for Radioactive Airborne Emissions*, Fluor Hanford Group, Inc., Richland Washington
- HNF-3602, Revision 1, 2002, *Calculating Potential-to-Emit Release and Dose for FEMP and NOCs*. Fluor Hanford. Group Inc., Richland, Washington.

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RPP-MP-600, 2000, *QA Program Description for the Tank Farm Contractor*, CH2M HILL Hanford Group, Inc., Richland, Washington.

HNF-4327, Revision 1A, 2002, *Control of Airborne Radioactive Emissions for Frequently Performed TWRS Work Activities (ALARACT Demonstrations)*, CH2MHILL Hanford Group, Inc., Richland, Washington.

HNF-5267, Revision 2, 1999, *Waste Retrieval Sluicing System Campaign Number 3 Solids Volume Transferred Calculation*, Lockheed Martin Hanford Corp., Richland, Washington.

WAC 197-11-845, *State Environmental Policy Act*, "SEPA Rules, Department of Social and Health Services," *Washington Administration Code*, as amended.

WAC 246-247, "Radiation Protection – Air Emissions," *Washington Administrative Code*, as amended.

## Appendix A

### Calculations for Pit Opening

Pit Openings and Ventilation Hatchway at C-200 Series Tanks To Support Retrieval

Release Fraction	1.00E-03								
Maximum Interior Surface Area of Four Pits + Ventilation Hatchways * 2 (to take into account equipment in the pits)	5.66E+06	cm <sup>2</sup>	6.09E+03	ft <sup>2</sup>					
Number of Entries (M)	16								
	Max. Smear Removable Concentration (dpm/100 cm <sup>2</sup> )*	Conversion (dpm/100cm <sup>2</sup> to (Ci/cm <sup>2</sup> ))	Max Smear Concentration Ci/cm <sup>2</sup> )	Possession Quantity (Ci)	Unabated Offsite Release (Ci/Yr)	Offsite Dose Factor (mrem/Ci) [a]	Unabated Offsite Dose (mrem/yr)	Onsite Dose Factor (mrem/Ci) [a]	Unabated Onsite Dose (mrem/yr)
	A	B	C=A*B	D=(SA)*C*M	E=RF*D	G	H=E*G	G	H=E*G
Alpha (Am-241)	1400	4.50E-15	6.30E-12	5.70E-04	5.70E-07	1.30E+01	7.42E-06	1.50E+01	8.56E-06
Beta (Sr-90)	1.00E+06	4.50E-15	4.50E-09	4.07E-01	4.07E-04	1.10E-01	4.48E-05	9.50E-03	3.87E-06
Total				4.08E-01	4.08E-04		5.22E-05		1.24E-05

<sup>111</sup> Each concrete Jet Pump Pit (one per tank) is approximately 5'9" x 9' x 10' deep (H-2-41843). = ft<sup>2</sup>

1594

<sup>111</sup> Each concrete Ventilation Hatchway (two per tank) is approximately 3'3" x 5'9" x 8' deep. = ft<sup>2</sup>

1451

Tank access is through a 24" diameter doglegged stoneware pipe (see drawing D-20 in CVI file #73550).

Conversion from ft<sup>2</sup> \* (144in<sup>2</sup>/1ft<sup>2</sup>)\*(6.452cm<sup>2</sup>/1in<sup>2</sup>) = cm<sup>2</sup>

No radiological survey data is available for the Jet Pump Pits or Ventilation Hatchways

## Appendix A (continued)

Pit Openings at AY-101 to Support C-200 Series Retrieval

Release Fraction	1.00E-03								
Maximum Interior Surface Area of Two Pits * 2 (to take into account equipment in the pits)	1.25E+06	cm <sup>2</sup>	1.34E+03	ft <sup>2</sup>					
Number of Entries (M)	4								
	Max. Smear Removable Concentration (dpm/100 cm <sup>2</sup> )*	Conversion (dpm/100cm <sup>2</sup> ) to (Ci/cm <sup>2</sup> )	Max Smear Concentration (Ci/cm <sup>2</sup> )	Possession Quantity (Ci)	Unabated Release (Ci/Yr)	Onsite Dose Factor (mrem/Ci) [a]	Unabated Offsite Dose (mrem/yr)	Onsite Dose Factor (mrem/Ci) [a]	Unabated Onsite Dose (mrem/yr)
	A	B	C=A*B	D=(SA)*C*M	E=RF*D	G	H=E*G	G	H=E*G
Alpha (Am-241)	20	4.50E-15	9.00E-14	4.50E-07	4.50E-10	1.30E+01	5.84E-09	1.50E+01	6.74E-09
Beta (Sr-90)	8.50E+05	4.50E-15	3.83E-09	1.91E-02	1.91E-05	1.10E-01	2.10E-06	9.50E-03	1.82E-07
Total				1.91E-02	1.91E-05		2.11E-06		1.88E-07

Heel Pit is 672 ft<sup>2</sup> interior surface area or 12 ft by 12 ft by 8 ft deep

672 ft<sup>2</sup>

Conversion from ft<sup>2</sup> \* (144in<sup>2</sup>/1ft<sup>2</sup>)\*(6.452cm<sup>2</sup>/1in<sup>2</sup>) = cm<sup>2</sup>

Heel Pit Survey Report No. DSTP-003007

Crack smears are the highest contamination smears and are translated over the entire pit interior for conservatism

## Appendix B

### Calculations for Equipment Removal

Potential Unabated Emissions and Dose for 241-C-201

For Equipment Removal Activities

Liquid Level reel	6.01E+01	in <sup>3</sup>
Thermocouple	2.30E+02	in <sup>3</sup>
Sluice Eductors	3.46E+02	in <sup>3</sup>
Total Contaminated Surface Area	636	in <sup>2</sup>
Waste Volume on Equipment * 2 volumes for conservatism	5.5043783	Gallons

Contamination on outside of equipment assume to be 1/16 - inch thick (0.0625 inch)

Analyte	Inventory Ci	Ci per gallon	Inventory on Equipment Ci	Release Fraction	Unabated Release Ci	Cap-88 OffSite MPR mrem/Ci	Offsite Unabated Dose mrem/yr	Contribution to Dose %	Cap-88 Onsite MPR mrem/Ci	Onsite Unabated Dose mrem/yr	Contribution to Dose %
	A	B	C=B*Vol	D	E=C*D	F	H=E*F	I=H/Sum of H	J	K=E*J	L=H/Sum of H
3H	9.80E-04	9.80E-07	5.39E-06	1.00E+00	5.39E-06	2.50E-05	1.35E-10	0.00%	7.10E-06	3.83E-11	0.00%
14C	2.01E-03	2.01E-06	1.11E-05	1.00E+00	1.11E-05	1.90E-03	2.10E-08	0.00%	1.80E-04	1.99E-09	0.00%
60Co	8.42E-04	8.42E-07	4.63E-06	1.00E-03	4.63E-09	2.50E-01	1.16E-09	0.00%	3.00E-01	1.39E-09	0.00%
59Ni	7.52E-01	7.52E-04	4.14E-03	1.00E-03	4.14E-06	3.10E-04	1.28E-09	0.00%	2.90E-04	1.20E-09	0.00%
63Ni	7.00E+01	7.00E-02	3.85E-01	1.00E-03	3.85E-04	2.60E-04	1.00E-07	0.00%	6.90E-05	2.66E-08	0.00%
79Se	8.79E-04	8.79E-07	4.84E-06	1.00E-03	4.84E-09	1.30E-01	6.29E-10	0.00%	1.50E-01	7.26E-10	0.00%
90Sr	4.13E+02	4.13E-01	2.27E+00	1.00E-03	2.27E-03	1.10E-01	2.50E-04	4.54%	9.50E-03	2.16E-05	0.35%
90Y	4.13E+02	4.13E-01	2.27E+00	1.00E-03	2.27E-03	3.40E-04	7.73E-07	0.01%	2.60E-04	5.91E-07	0.01%
93Zr	3.88E-02	3.88E-05	2.14E-04	1.00E-03	2.14E-07	1.30E-03	2.78E-10	0.00%	1.30E-03	2.78E-10	0.00%
93mNb	3.45E-02	3.45E-05	1.90E-04	1.00E-03	1.90E-07	2.10E-03	3.99E-10	0.00%	1.20E-03	2.28E-10	0.00%
99Tc	1.41E-02	1.41E-05	7.76E-05	1.00E-03	7.76E-08	2.30E-02	1.79E-09	0.00%	1.40E-03	1.09E-10	0.00%
106Ru	1.36E-07	1.36E-10	7.49E-10	1.00E+00	7.49E-10	2.00E-02	1.50E-11	0.00%	1.90E-02	1.42E-11	0.00%
113mCd	7.20E-02	7.20E-05	3.96E-04	1.00E-03	3.96E-07	1.30E-01	5.15E-08	0.00%	1.50E-01	5.94E-08	0.00%
126Sn	5.61E-03	5.61E-06	3.09E-05	1.00E-03	3.09E-08	4.70E-02	1.45E-09	0.00%	4.10E-02	1.27E-09	0.00%
125Sb	1.41E-03	1.41E-06	7.76E-06	1.00E-03	7.76E-09	2.60E-02	2.02E-10	0.00%	3.30E-02	2.56E-10	0.00%
129I	2.74E-05	2.74E-08	1.51E-07	1.00E+00	1.51E-07	2.00E-01	3.02E-08	0.00%	2.20E-02	3.32E-09	0.00%
134Cs	7.46E-07	7.46E-10	4.11E-09	1.00E-03	4.11E-12	1.00E-01	4.11E-13	0.00%	4.70E-02	1.93E-13	0.00%
137Cs	7.87E+01	7.87E-02	4.33E-01	1.00E-03	4.33E-04	2.40E-01	1.04E-04	1.89%	2.70E-01	1.17E-04	1.92%
137mBa	7.45E+01	7.45E-02	4.10E-01	1.00E-03	4.10E-04	5.30E-13	2.17E-16	0.00%	1.00E-11	4.10E-15	0.00%
151Sm	3.12E+01	3.12E-02	1.72E-01	1.00E-03	1.72E-04	7.50E-04	1.29E-07	0.00%	8.40E-04	1.44E-07	0.00%
152Eu	4.05E-01	4.05E-04	2.23E-03	1.00E-03	2.23E-06	2.40E-01	5.35E-07	0.01%	3.10E-01	6.91E-07	0.01%



154Eu	1.91E-01	1.91E-04	1.05E-03	1.00E-03	1.05E-06	2.00E-01	2.10E-07	0.00%	2.50E-01	2.63E-07	0.00%
155Eu	1.42E+01	1.42E-02	7.82E-02	1.00E-03	7.82E-05	8.00E-03	6.25E-07	0.01%	9.80E-03	7.66E-07	0.01%
226Ra	6.52E-05	6.52E-08	3.59E-07	1.00E-03	3.59E-10	4.60E-01	1.65E-10	0.00%	2.50E-01	8.97E-11	0.00%
228Ra	1.78E-10	1.78E-13	9.80E-13	1.00E-03	9.80E-16	1.90E-01	1.86E-16	0.00%	7.00E-02	6.86E-17	0.00%
227Ac	2.56E-04	2.56E-07	1.41E-06	1.00E-03	1.41E-09	1.50E+01	2.11E-08	0.00%	1.80E+01	2.54E-08	0.00%
229Th	6.63E-08	6.63E-11	3.65E-10	1.00E-03	3.65E-13	1.60E+01	5.84E-12	0.00%	2.00E+01	7.30E-12	0.00%
232Th	4.78E-13	4.78E-16	2.63E-15	1.00E-03	2.63E-18	9.20E+00	2.42E-17	0.00%	1.20E+01	3.16E-17	0.00%
231Pa	8.65E-06	8.65E-09	4.76E-08	1.00E-03	4.76E-11	1.20E+01	5.71E-10	0.00%	1.40E+01	6.67E-10	0.00%
232U	4.15E-09	4.15E-12	2.28E-11	1.00E-03	2.28E-14	1.10E+01	2.51E-13	0.00%	1.30E+01	2.97E-13	0.00%
233U	2.66E-10	2.66E-13	1.46E-12	1.00E-03	1.46E-15	3.10E+00	4.54E-15	0.00%	3.70E+00	5.42E-15	0.00%
234U	3.75E-04	3.75E-07	2.06E-06	1.00E-03	2.06E-09	3.10E+00	6.40E-09	0.00%	3.70E+00	7.64E-09	0.00%
235U	1.69E-05	1.69E-08	9.30E-08	1.00E-03	9.30E-11	3.00E+00	2.79E-10	0.00%	3.50E+00	3.26E-10	0.00%
236U	2.39E-06	2.39E-09	1.32E-08	1.00E-03	1.32E-11	2.90E+00	3.82E-11	0.00%	3.50E+00	4.60E-11	0.00%
238U	3.80E-04	3.80E-07	2.09E-06	1.00E-03	2.09E-09	2.80E+00	5.86E-09	0.00%	3.30E+00	6.90E-09	0.00%
237Np	4.28E-05	4.28E-08	2.36E-07	1.00E-03	2.36E-10	1.20E+01	2.83E-09	0.00%	1.40E+01	3.30E-09	0.00%
238Pu	1.45E+00	1.45E-03	7.98E-03	1.00E-03	7.98E-06	7.60E+00	6.07E-05	1.10%	8.90E+00	7.10E-05	1.16%
239Pu	6.48E+01	6.48E-02	3.57E-01	1.00E-03	3.57E-04	8.20E+00	2.92E-03	53.12%	9.50E+00	3.39E-03	55.55%
240Pu	1.07E+01	1.07E-02	5.89E-02	1.00E-03	5.89E-05	8.20E+00	4.83E-04	8.77%	9.50E+00	5.60E-04	9.17%
241Pu	7.92E+01	7.92E-02	4.36E-01	1.00E-03	4.36E-04	1.30E+01	5.67E-05	1.03%	1.50E+01	6.54E-05	1.07%
242Pu	5.46E-04	5.46E-07	3.01E-06	1.00E-03	3.01E-09	7.80E+00	2.34E-08	0.00%	9.10E+00	2.73E-08	0.00%
241Am	2.27E+01	2.27E-02	1.25E-01	1.00E-03	1.25E-04	1.30E+01	1.62E-03	29.50%	1.50E+01	1.87E-03	30.72%
243Am	5.26E-04	5.26E-07	2.90E-06	1.00E-03	2.90E-09	1.30E+01	3.76E-08	0.00%	1.50E+01	4.34E-08	0.00%
242Cm	3.41E-02	3.41E-05	1.88E-04	1.00E-03	1.88E-07	4.10E-01	7.70E-08	0.00%	5.00E-01	9.38E-08	0.00%
243Cm	1.63E-03	1.63E-06	8.97E-06	1.00E-03	8.97E-09	8.50E+00	7.63E-08	0.00%	1.00E+01	8.97E-08	0.00%
244Cm	7.20E-04	7.20E-07	3.96E-06	1.00E-03	3.96E-09	6.70E+00	2.66E-08	0.00%	8.00E+00	3.17E-08	0.00%
	1.28E+03		7.02E+00			Total	5.51E-03	100.00%		6.10E-03	100.00%

C-200 series liquid level reels are 24 ft x 1 in diameter

C-200 thermocouples are 24 ft x 4 in diameter

C-200 series sluice eductors (two 3-in hoses) are 24 ft. length in each tank

Total volume of tank contents are 1,000 gallons per HNF-EP-0182, Rev. 175

## Appendix B

### Calculations for Equipment Removal Continued

Potential Unabated Emissions and Dose for 241-C-202

For Equipment Removal Activities

Liquid Level reel	6.01E+01	in <sup>3</sup>
Thermocouple	2.30E+02	in <sup>3</sup>
Sluice Eductors	3.46E+02	in <sup>3</sup>
Total Contaminated Surface Area	636	In <sup>2</sup>
Waste Volume on Equipment * 2 volumes for conservatism	5.5043783	Gallons

Contamination on outside of equipment assume to be 1/16 - inch thick (0.0625 inch)

Analyte	Inventory Ci	Ci per gallon	Inventory on Equipment Ci/gal	Release Fraction	Unabated Release Ci	Cap-88 OffSite MPR mrem/Ci	Offsite Unabated Dose mrem/yr	Contribution to Dose %	Cap-88 Onsite MPR mrem/Ci	Onsite Unabated Dose mrem/yr	Contribution to Dose %
	A	B	C=B*Vol	D	E=C*D	F	H=E*F	I=H/Sum of H	J	K=E*J	L=H/Sum of H
3H	1.02E-03	1.02E-06	5.61E-06	1.00E+00	5.61E-06	2.50E-05	1.40E-10	0.00%	7.10E-06	3.99E-11	0.00%
14C	2.09E-03	2.09E-06	1.15E-05	1.00E+00	1.15E-05	1.90E-03	2.19E-08	0.00%	1.80E-04	2.07E-09	0.00%
60Co	8.77E-04	8.77E-07	4.83E-06	1.00E-03	4.83E-09	2.50E-01	1.21E-09	0.00%	3.00E-01	1.45E-09	0.00%
59Ni	7.84E-01	7.84E-04	4.32E-03	1.00E-03	4.32E-06	3.10E-04	1.34E-09	0.00%	2.90E-04	1.25E-09	0.00%
63Ni	7.29E+01	7.29E-02	4.01E-01	1.00E-03	4.01E-04	2.60E-04	1.04E-07	0.00%	6.90E-05	2.77E-08	0.00%
79Se	9.16E-04	9.16E-07	5.04E-06	1.00E-03	5.04E-09	1.30E-01	6.55E-10	0.00%	1.50E-01	7.56E-10	0.00%
90Sr	4.31E+02	4.31E-01	2.37E+00	1.00E-03	2.37E-03	1.10E-01	2.61E-04	8.51%	9.50E-03	2.25E-05	0.69%
90Y	4.31E+02	4.31E-01	2.37E+00	1.00E-03	2.37E-03	3.40E-04	8.07E-07	0.03%	2.60E-04	6.17E-07	0.02%
93Zr	4.04E-02	4.04E-05	2.22E-04	1.00E-03	2.22E-07	1.30E-03	2.89E-10	0.00%	1.30E-03	2.89E-10	0.00%
93mNb	3.59E-02	3.59E-05	1.98E-04	1.00E-03	1.98E-07	2.10E-03	4.15E-10	0.00%	1.20E-03	2.37E-10	0.00%
99Tc	1.47E-02	1.47E-05	8.09E-05	1.00E-03	8.09E-08	2.30E-02	1.86E-09	0.00%	1.40E-03	1.13E-10	0.00%
106Ru	1.42E-07	1.42E-10	7.82E-10	1.00E+00	7.82E-10	2.00E-02	1.56E-11	0.00%	1.90E-02	1.49E-11	0.00%
113mCd	7.50E-02	7.50E-05	4.13E-04	1.00E-03	4.13E-07	1.30E-01	5.37E-08	0.00%	1.50E-01	6.19E-08	0.00%
126Sn	5.85E-03	5.85E-06	3.22E-05	1.00E-03	3.22E-08	4.70E-02	1.51E-09	0.00%	4.10E-02	1.32E-09	0.00%
125Sb	1.47E-03	1.47E-06	8.09E-06	1.00E-03	8.09E-09	2.60E-02	2.10E-10	0.00%	3.30E-02	2.67E-10	0.00%
129I	2.85E-05	2.85E-08	1.57E-07	1.00E+00	1.57E-07	2.00E-01	3.14E-08	0.00%	2.20E-02	3.45E-09	0.00%
134Cs	7.78E-07	7.78E-10	4.28E-09	1.00E-03	4.28E-12	1.00E-01	4.28E-13	0.00%	4.70E-02	2.01E-13	0.00%
137Cs	8.22E+01	8.22E-02	4.52E-01	1.00E-03	4.52E-04	2.40E-01	1.09E-04	3.54%	2.70E-01	1.22E-04	3.74%
137mBa	7.77E+01	7.77E-02	4.28E-01	1.00E-03	4.28E-04	5.30E-13	2.27E-16	0.00%	1.00E-11	4.28E-15	0.00%
151Sm	3.25E+01	3.25E-02	1.79E-01	1.00E-03	1.79E-04	7.50E-04	1.34E-07	0.00%	8.40E-04	1.50E-07	0.00%
152Eu	4.22E-01	4.22E-04	2.32E-03	1.00E-03	2.32E-06	2.40E-01	5.57E-07	0.02%	3.10E-01	7.20E-07	0.02%
154Eu	1.99E-01	1.99E-04	1.10E-03	1.00E-03	1.10E-06	2.00E-01	2.19E-07	0.01%	2.50E-01	2.74E-07	0.01%
155Eu	1.48E+01	1.48E-02	8.15E-02	1.00E-03	8.15E-05	8.00E-03	6.52E-07	0.02%	9.80E-03	7.98E-07	0.02%

226Ra	6.79E-05	6.79E-08	3.74E-07	1.00E-03	3.74E-10	4.60E-01	1.72E-10	0.00%	2.50E-01	9.34E-11	0.00%
228Ra	1.85E-10	1.85E-13	1.02E-12	1.00E-03	1.02E-15	1.90E-01	1.93E-16	0.00%	7.00E-02	7.13E-17	0.00%
227Ac	2.66E-04	2.66E-07	1.46E-06	1.00E-03	1.46E-09	1.50E+01	2.20E-08	0.00%	1.80E+01	2.64E-08	0.00%
229Th	6.91E-08	6.91E-11	3.80E-10	1.00E-03	3.80E-13	1.60E+01	6.09E-12	0.00%	2.00E+01	7.61E-12	0.00%
232Th	4.98E-13	4.98E-16	2.74E-15	1.00E-03	2.74E-18	9.20E+00	2.52E-17	0.00%	1.20E+01	3.29E-17	0.00%
231Pa	9.01E-06	9.01E-09	4.96E-08	1.00E-03	4.96E-11	1.20E+01	5.95E-10	0.00%	1.40E+01	6.94E-10	0.00%
232U	2.60E-08	2.60E-11	1.43E-10	1.00E-03	1.43E-13	1.10E+01	1.57E-12	0.00%	1.30E+01	1.86E-12	0.00%
233U	7.31E-10	7.31E-13	4.02E-12	1.00E-03	4.02E-15	3.10E+00	1.25E-14	0.00%	3.70E+00	1.49E-14	0.00%
234U	3.99E-04	3.99E-07	2.20E-06	1.00E-03	2.20E-09	3.10E+00	6.81E-09	0.00%	3.70E+00	8.13E-09	0.00%
235U	1.68E-05	1.68E-08	9.25E-08	1.00E-03	9.25E-11	3.00E+00	2.77E-10	0.00%	3.50E+00	3.24E-10	0.00%
236U	9.28E-06	9.28E-09	5.11E-08	1.00E-03	5.11E-11	2.90E+00	1.48E-10	0.00%	3.50E+00	1.79E-10	0.00%
238U	3.96E-04	3.96E-07	2.18E-06	1.00E-03	2.18E-09	2.80E+00	6.10E-09	0.00%	3.30E+00	7.19E-09	0.00%
237Np	4.46E-05	4.46E-08	2.45E-07	1.00E-03	2.45E-10	1.20E+01	2.95E-09	0.00%	1.40E+01	3.44E-09	0.00%
238Pu	7.62E-01	7.62E-04	4.19E-03	1.00E-03	4.19E-06	7.60E+00	3.19E-05	1.04%	8.90E+00	3.73E-05	1.14%
239Pu	3.39E+01	3.39E-02	1.87E-01	1.00E-03	1.87E-04	8.20E+00	1.53E-03	49.89%	9.50E+00	1.77E-03	54.28%
240Pu	5.57E+00	5.57E-03	3.07E-02	1.00E-03	3.07E-05	8.20E+00	2.51E-04	8.20%	9.50E+00	2.91E-04	8.92%
241Pu	4.14E+01	4.14E-02	2.28E-01	1.00E-03	2.28E-04	1.30E-01	2.96E-05	0.97%	1.50E-01	3.42E-05	1.05%
242Pu	2.85E-04	2.85E-07	1.57E-06	1.00E-03	1.57E-09	7.80E+00	1.22E-08	0.00%	9.10E+00	1.43E-08	0.00%
241Am	1.19E+01	1.19E-02	6.55E-02	1.00E-03	6.55E-05	1.30E+01	8.52E-04	27.77%	1.50E+01	9.83E-04	30.09%
243Am	2.75E-04	2.75E-07	1.51E-06	1.00E-03	1.51E-09	1.30E+01	1.97E-08	0.00%	1.50E+01	2.27E-08	0.00%
242Cm	1.78E-02	1.78E-05	9.80E-05	1.00E-03	9.80E-08	4.10E-01	4.02E-08	0.00%	5.00E-01	4.90E-08	0.00%
243Cm	8.52E-04	8.52E-07	4.69E-06	1.00E-03	4.69E-09	8.50E+00	3.99E-08	0.00%	1.00E+01	4.69E-08	0.00%
244Cm	3.76E-04	3.76E-07	2.07E-06	1.00E-03	2.07E-09	6.70E+00	1.39E-08	0.00%	8.00E+00	1.66E-08	0.00%
1.24E+03		6.81E+00		Total		3.07E-03	100.00%			3.27E-03	100.00%

C-200 series liquid level reels are 24 ft x 1 in diameter

C-200 thermocouples are 24 ft x 4 in diameter

C-200 series sluice eductors (two 3-in hoses) are 24 ft. length in each tank

Total volume of tank contents are 1,000 gallons per HNF-EP-0182, Rev. 175

## Appendix B Calculations for Equipment Removal Continued

Potential Unabated Emissions and Dose for 241-C-203

For Equipment Removal Activities

Liquid Level reel	6.01E+01	in <sup>3</sup>
Thermocouple	2.30E+02	in <sup>3</sup>
Sluice Eductors	3.46E+02	in <sup>3</sup>
Total Contaminated Surface Area	636	In <sup>2</sup>
Waste Volume on Equipment * 2 volumes for conservatism	5.5043783	Gallons

Contamination on outside of equipment assume to be 1/16 - inch thick (0.0625 inch)

Analyte	Inventory Ci	Ci per gallon	Inventory on Equipment Ci/gal	Release Fraction	Unabated Release Ci	Cap-88 Offsite MPR mrem/Ci	Offsite Unabated Dose mrem/yr	Contribution to Dose %	Cap-88 Onsite MPR mrem/Ci	Onsite Unabated Dose mrem/yr	Contribution to Dose %
	A	B	C=B*Vol	D	E=C*D	F	H=E*F	I=H/Sum of H	J	K=E*J	L=H/Sum of H
3H	1.95E-03	6.50E-07	3.58E-06	1.00E+00	3.58E-06	2.50E-05	8.94E-11	0.00%	7.10E-06	2.54E-11	0.00%
14C	4.00E-03	1.33E-06	7.34E-06	1.00E+00	7.34E-06	1.90E-03	1.39E-08	0.00%	1.80E-04	1.32E-09	0.00%
60Co	1.68E-03	5.60E-07	3.08E-06	1.00E-03	3.08E-09	2.50E-01	7.71E-10	0.00%	3.00E-01	9.25E-10	0.00%
59Ni	1.50E+00	5.00E-04	2.75E-03	1.00E-03	2.75E-06	3.10E-04	8.53E-10	0.00%	2.90E-04	7.98E-10	0.00%
63Ni	1.40E+02	4.67E-02	2.57E-01	1.00E-03	2.57E-04	2.60E-04	6.68E-08	0.01%	6.90E-05	1.77E-08	0.00%
79Se	1.75E-03	5.83E-07	3.21E-06	1.00E-03	3.21E-09	1.30E-01	4.17E-10	0.00%	1.50E-01	4.82E-10	0.00%
90Sr	8.23E+02	2.74E-01	1.51E+00	1.00E-03	1.51E-03	1.10E-01	1.66E-04	24.18%	9.50E-03	1.43E-05	2.33%
90Y	8.23E+02	2.74E-01	1.51E+00	1.00E-03	1.51E-03	3.40E-04	5.13E-07	0.07%	2.60E-04	3.93E-07	0.06%
93Zr	7.73E-02	2.58E-05	1.42E-04	1.00E-03	1.42E-07	1.30E-03	1.84E-10	0.00%	1.30E-03	1.84E-10	0.00%
93mNb	6.88E-02	2.29E-05	1.26E-04	1.00E-03	1.26E-07	2.10E-03	2.65E-10	0.00%	1.20E-03	1.51E-10	0.00%
99Tc	2.82E-02	9.40E-06	5.17E-05	1.00E-03	5.17E-08	2.30E-02	1.19E-09	0.00%	1.40E-03	7.24E-11	0.00%
106Ru	2.71E-07	9.03E-11	4.97E-10	1.00E+00	4.97E-10	2.00E-02	9.94E-12	0.00%	1.90E-02	9.45E-12	0.00%
113mCd	1.44E-01	4.80E-05	2.64E-04	1.00E-03	2.64E-07	1.30E-01	3.43E-08	0.01%	1.50E-01	3.96E-08	0.01%
126Sn	1.12E-02	3.73E-06	2.05E-05	1.00E-03	2.05E-08	4.70E-02	9.66E-10	0.00%	4.10E-02	8.43E-10	0.00%
125Sb	2.81E-03	9.37E-07	5.16E-06	1.00E-03	5.16E-09	2.60E-02	1.34E-10	0.00%	3.30E-02	1.70E-10	0.00%
129I	5.46E-05	1.82E-08	1.00E-07	1.00E+00	1.00E-07	2.00E-01	2.00E-08	0.00%	2.20E-02	2.20E-09	0.00%
134Cs	1.49E-06	4.97E-10	2.73E-09	1.00E-03	2.73E-12	1.00E-01	2.73E-13	0.00%	4.70E-02	1.28E-13	0.00%
137Cs	1.57E+02	5.23E-02	2.88E-01	1.00E-03	2.88E-04	2.40E-01	6.91E-05	10.07%	2.70E-01	7.78E-05	12.66%
137mBa	1.48E+02	4.93E-02	2.72E-01	1.00E-03	2.72E-04	5.30E-13	1.44E-16	0.00%	1.00E-11	2.72E-15	0.00%
151Sm	6.22E+01	2.07E-02	1.14E-01	1.00E-03	1.14E-04	7.50E-04	8.56E-08	0.01%	8.40E-04	9.59E-08	0.02%
152Eu	8.08E-01	2.69E-04	1.48E-03	1.00E-03	1.48E-06	2.40E-01	3.56E-07	0.05%	3.10E-01	4.60E-07	0.07%

154Eu	3.80E-01	1.27E-04	6.97E-04	1.00E-03	6.97E-07	2.00E-01	1.39E-07	0.02%	2.50E-01	1.74E-07	0.03%
155Eu	2.83E+01	9.43E-03	5.19E-02	1.00E-03	5.19E-05	8.00E-03	4.15E-07	0.06%	9.80E-03	5.09E-07	0.08%
226Ra	1.30E-04	4.33E-08	2.39E-07	1.00E-03	2.39E-10	4.60E-01	1.10E-10	0.00%	2.50E-01	5.96E-11	0.00%
228Ra	3.54E-10	1.18E-13	6.50E-13	1.00E-03	6.50E-16	1.90E-01	1.23E-16	0.00%	7.00E-02	4.55E-17	0.00%
227Ac	5.10E-04	1.70E-07	9.36E-07	1.00E-03	9.36E-10	1.50E+01	1.40E-08	0.00%	1.80E+01	1.68E-08	0.00%
229Th	1.32E-07	4.40E-11	2.42E-10	1.00E-03	2.42E-13	1.60E+01	3.88E-12	0.00%	2.00E+01	4.84E-12	0.00%
232Th	9.54E-13	3.18E-16	1.75E-15	1.00E-03	1.75E-18	9.20E+00	1.61E-17	0.00%	1.20E+01	2.10E-17	0.00%
231Pa	1.73E-05	5.77E-09	3.17E-08	1.00E-03	3.17E-11	1.20E+01	3.81E-10	0.00%	1.40E+01	4.44E-10	0.00%
232U	8.27E-09	2.76E-12	1.52E-11	1.00E-03	1.52E-14	1.10E+01	1.67E-13	0.00%	1.30E+01	1.97E-13	0.00%
233U	5.30E-10	1.77E-13	9.72E-13	1.00E-03	9.72E-16	3.10E+00	3.01E-15	0.00%	3.70E+00	3.60E-15	0.00%
234U	7.47E-04	2.49E-07	1.37E-06	1.00E-03	1.37E-09	3.10E+00	4.25E-09	0.00%	3.70E+00	5.07E-09	0.00%
235U	3.36E-05	1.12E-08	6.16E-08	1.00E-03	6.16E-11	3.00E+00	1.85E-10	0.00%	3.50E+00	2.16E-10	0.00%
236U	4.77E-06	1.59E-09	8.75E-09	1.00E-03	8.75E-12	2.90E+00	2.54E-11	0.00%	3.50E+00	3.06E-11	0.00%
238U	7.56E-04	2.52E-07	1.39E-06	1.00E-03	1.39E-09	2.80E+00	3.88E-09	0.00%	3.30E+00	4.58E-09	0.00%
237Np	8.53E-05	2.84E-08	1.57E-07	1.00E-03	1.57E-10	1.20E+01	1.88E-09	0.00%	1.40E+01	2.19E-09	0.00%
238Pu	3.81E-01	1.27E-04	6.99E-04	1.00E-03	6.99E-07	7.60E+00	5.31E-06	0.77%	8.90E+00	6.22E-06	1.01%
239Pu	1.70E+01	5.67E-03	3.12E-02	1.00E-03	3.12E-05	8.20E+00	2.56E-04	37.24%	9.50E+00	2.96E-04	48.22%
240Pu	2.79E+00	9.30E-04	5.12E-03	1.00E-03	5.12E-06	8.20E+00	4.20E-05	6.11%	9.50E+00	4.86E-05	7.91%
241Pu	2.07E+01	6.90E-03	3.80E-02	1.00E-03	3.80E-05	1.30E-01	4.94E-06	0.72%	1.50E-01	5.70E-06	0.93%
242Pu	1.43E-04	4.77E-08	2.62E-07	1.00E-03	2.62E-10	7.80E+00	2.05E-09	0.00%	9.10E+00	2.39E-09	0.00%
241Am	5.95E+00	1.98E-03	1.09E-02	1.00E-03	1.09E-05	1.30E+01	1.42E-04	20.66%	1.50E+01	1.64E-04	26.65%
243Am	1.37E-04	4.57E-08	2.51E-07	1.00E-03	2.51E-10	1.30E+01	3.27E-09	0.00%	1.50E+01	3.77E-09	0.00%
242Cm	8.93E-03	2.98E-06	1.64E-05	1.00E-03	1.64E-08	4.10E-01	6.72E-09	0.00%	5.00E-01	8.19E-09	0.00%
243Cm	4.26E-04	1.42E-07	7.82E-07	1.00E-03	7.82E-10	8.50E+00	6.64E-09	0.00%	1.00E+01	7.82E-09	0.00%
244Cm	1.88E-04	6.27E-08	3.45E-07	1.00E-03	3.45E-10	6.70E+00	2.31E-09	0.00%	8.00E+00	2.76E-09	0.00%
2.23E+03		4.09E+00		Total		6.87E-04	100.00%			6.14E-04	100.00%

C-200 series liquid level reels are 24 ft x 1 in diameter

C-200 thermocouples are 24 ft x 4 in diameter

C-200 series sluice eductors (two 3-in hoses) are 24 ft. length in each tank

Total volume of tank contents is 3000 gallons per HNF-EP-0182, Rev. 175

## Appendix B Calculations for Equipment Removal Continued

Potential Unabated Emissions and Dose for 241-C-204

For Equipment Removal Activities

Liquid Level reel	6.01E+01	in <sup>3</sup>
Thermocouple	2.30E+02	in <sup>3</sup>
Sluice Eductors	3.46E+02	in <sup>3</sup>
Sluice Pump	4.56E+02	in <sup>3</sup>
Total Contamination Held on Outside of Equipment	1.09E+03	In <sup>3</sup>
Waste Volume on Equipment * 2 volumes for conservatism	9.45E+00	Gallons

Contamination on outside of equipment assume to be 1/16 - inch thick (0.0625 inch)

Analyte	Inventory Ci	Ci per gallon	Inventory on Equipment Ci/gal	Release Fraction	Unabated Release Ci	Cap-88 OffSite MPR mrem/Ci	Offsite Unabated Dose mrem/yr	Contribution to Dose %	Cap-88 Onsite MPR mrem/Ci	Onsite Unabated Dose mrem/yr	Contribution to Dose %
	A	B	C=B*Vol	D	E=C*D	F	H=E*F	I=H/Sum of H	J	K=E*J	L=H/Sum of H
3H	1.26E-03	4.20E-07	3.97E-06	1.00E+00	3.97E-06	2.50E-05	9.92E-11	0.00%	7.10E-06	2.82E-11	0.00%
14C	2.58E-03	8.60E-07	8.13E-06	1.00E+00	8.13E-06	1.90E-03	1.54E-08	0.01%	1.80E-04	1.46E-09	0.00%
60Co	1.08E-03	3.60E-07	3.40E-06	1.00E-03	3.40E-09	2.50E-01	8.50E-10	0.00%	3.00E-01	1.02E-09	0.00%
59Ni	9.66E-01	3.22E-04	3.04E-03	1.00E-03	3.04E-06	3.10E-04	9.43E-10	0.00%	2.90E-04	8.82E-10	0.00%
63Ni	8.99E+01	3.00E-02	2.83E-01	1.00E-03	2.83E-04	2.60E-04	7.36E-08	0.03%	6.90E-05	1.95E-08	0.02%
79Se	1.13E-03	3.77E-07	3.56E-06	1.00E-03	3.56E-09	1.30E-01	4.63E-10	0.00%	1.50E-01	5.34E-10	0.00%
90Sr	5.32E+02	1.77E-01	1.68E+00	1.00E-03	1.68E-03	1.10E-01	1.84E-04	66.24%	9.50E-03	1.59E-05	13.05%
90Y	5.32E+02	1.77E-01	1.68E+00	1.00E-03	1.68E-03	3.40E-04	5.70E-07	0.20%	2.60E-04	4.36E-07	0.36%
93Zr	4.98E-02	1.66E-05	1.57E-04	1.00E-03	1.57E-07	1.30E-03	2.04E-10	0.00%	1.30E-03	2.04E-10	0.00%
93mNb	4.43E-02	1.48E-05	1.40E-04	1.00E-03	1.40E-07	2.10E-03	2.93E-10	0.00%	1.20E-03	1.67E-10	0.00%
99Tc	1.81E-02	6.03E-06	5.70E-05	1.00E-03	5.70E-08	2.30E-02	1.31E-09	0.00%	1.40E-03	7.98E-11	0.00%
106Ru	1.75E-07	5.83E-11	5.51E-10	1.00E+00	5.51E-10	2.00E-02	1.10E-11	0.00%	1.90E-02	1.05E-11	0.00%
113mCd	9.24E-02	3.08E-05	2.91E-04	1.00E-03	2.91E-07	1.30E-01	3.78E-08	0.01%	1.50E-01	4.37E-08	0.04%
126Sn	7.21E-03	2.40E-06	2.27E-05	1.00E-03	2.27E-08	4.70E-02	1.07E-09	0.00%	4.10E-02	9.31E-10	0.00%
125Sb	1.81E-03	6.03E-07	5.70E-06	1.00E-03	5.70E-09	2.60E-02	1.48E-10	0.00%	3.30E-02	1.88E-10	0.00%
129I	3.52E-05	1.17E-08	1.11E-07	1.00E+00	1.11E-07	2.00E-01	2.22E-08	0.01%	2.20E-02	2.44E-09	0.00%
134Cs	9.59E-07	3.20E-10	3.02E-09	1.00E-03	3.02E-12	1.00E-01	3.02E-13	0.00%	4.70E-02	1.42E-13	0.00%
137Cs	1.01E+02	3.37E-02	3.18E-01	1.00E-03	3.18E-04	2.40E-01	7.63E-05	27.44%	2.70E-01	8.59E-05	70.44%
137mBa	9.59E+01	3.20E-02	3.02E-01	1.00E-03	3.02E-04	5.30E-13	1.60E-16	0.00%	1.00E-11	3.02E-15	0.00%
151Sm	4.01E+01	1.34E-02	1.26E-01	1.00E-03	1.26E-04	7.50E-04	9.47E-08	0.03%	8.40E-04	1.06E-07	0.09%
152Eu	5.20E-01	1.73E-04	1.64E-03	1.00E-03	1.64E-06	2.40E-01	3.93E-07	0.14%	3.10E-01	5.08E-07	0.42%

154Eu	2.45E-01	8.17E-05	7.72E-04	1.00E-03	7.72E-07	2.00E-01	1.54E-07	0.06%	2.50E-01	1.93E-07	0.16%
155Eu	1.82E+01	6.07E-03	5.73E-02	1.00E-03	5.73E-05	8.00E-03	4.59E-07	0.16%	9.80E-03	5.62E-07	0.46%
226Ra	8.37E-05	2.79E-08	2.64E-07	1.00E-03	2.64E-10	4.60E-01	1.21E-10	0.00%	2.50E-01	6.59E-11	0.00%
228Ra	2.28E-10	7.60E-14	7.18E-13	1.00E-03	7.18E-16	1.90E-01	1.36E-16	0.00%	7.00E-02	5.03E-17	0.00%
227Ac	3.28E-04	1.09E-07	1.03E-06	1.00E-03	1.03E-09	1.50E+01	1.55E-08	0.01%	1.80E+01	1.86E-08	0.02%
229Th	8.52E-08	2.84E-11	2.68E-10	1.00E-03	2.68E-13	1.60E+01	4.29E-12	0.00%	2.00E+01	5.37E-12	0.00%
232Th	6.14E-13	2.05E-16	1.93E-15	1.00E-03	1.93E-18	9.20E+00	1.78E-17	0.00%	1.20E+01	2.32E-17	0.00%
231Pa	1.11E-05	3.70E-09	3.50E-08	1.00E-03	3.50E-11	1.20E+01	4.20E-10	0.00%	1.40E+01	4.89E-10	0.00%
232U	5.35E-09	1.78E-12	1.69E-11	1.00E-03	1.69E-14	1.10E+01	1.85E-13	0.00%	1.30E+01	2.19E-13	0.00%
233U	3.42E-10	1.14E-13	1.08E-12	1.00E-03	1.08E-15	3.10E+00	3.34E-15	0.00%	3.70E+00	3.99E-15	0.00%
234U	4.82E-04	1.61E-07	1.52E-06	1.00E-03	1.52E-09	3.10E+00	4.71E-09	0.00%	3.70E+00	5.62E-09	0.00%
235U	2.17E-05	7.23E-09	6.83E-08	1.00E-03	6.83E-11	3.00E+00	2.05E-10	0.00%	3.50E+00	2.39E-10	0.00%
236U	3.08E-06	1.03E-09	9.70E-09	1.00E-03	9.70E-12	2.90E+00	2.81E-11	0.00%	3.50E+00	3.40E-11	0.00%
238U	4.89E-04	1.63E-07	1.54E-06	1.00E-03	1.54E-09	2.80E+00	4.31E-09	0.00%	3.30E+00	5.08E-09	0.00%
237Np	5.49E-05	1.83E-08	1.73E-07	1.00E-03	1.73E-10	1.20E+01	2.08E-09	0.00%	1.40E+01	2.42E-09	0.00%
238Pu	7.76E-03	2.59E-06	2.44E-05	1.00E-03	2.44E-08	7.60E+00	1.86E-07	0.07%	8.90E+00	2.18E-07	0.18%
239Pu	3.47E-01	1.16E-04	1.09E-03	1.00E-03	1.09E-06	8.20E+00	8.96E-06	3.22%	9.50E+00	1.04E-05	8.51%
240Pu	5.69E-02	1.90E-05	1.79E-04	1.00E-03	1.79E-07	8.20E+00	1.47E-06	0.53%	9.50E+00	1.70E-06	1.40%
241Pu	4.23E-01	1.41E-04	1.33E-03	1.00E-03	1.33E-06	1.30E-01	1.73E-07	0.06%	1.50E-01	2.00E-07	0.16%
242Pu	2.92E-06	9.73E-10	9.20E-09	1.00E-03	9.20E-12	7.80E+00	7.17E-11	0.00%	9.10E+00	8.37E-11	0.00%
241Am	1.21E-01	4.03E-05	3.81E-04	1.00E-03	3.81E-07	1.30E+01	4.95E-06	1.78%	1.50E+01	5.72E-06	4.69%
243Am	2.80E-06	9.33E-10	8.82E-09	1.00E-03	8.82E-12	1.30E+01	1.15E-10	0.00%	1.50E+01	1.32E-10	0.00%
242Cm	1.81E-04	6.03E-08	5.70E-07	1.00E-03	5.70E-10	4.10E-01	2.34E-10	0.00%	5.00E-01	2.85E-10	0.00%
243Cm	8.70E-06	2.90E-09	2.74E-08	1.00E-03	2.74E-11	8.50E+00	2.33E-10	0.00%	1.00E+01	2.74E-10	0.00%
244Cm	3.84E-06	1.28E-09	1.21E-08	1.00E-03	1.21E-11	6.70E+00	8.10E-11	0.00%	8.00E+00	9.68E-11	0.00%
1.41E+03		4.45E+00		Total		2.78E-04	100.00%		1.22E-04	100.00%	

C-200 series liquid level reets are 24 ft x 1 in diameter

C-200 thermocouples are 24 ft x 4 in diameter

C-200 series sluice eductors (two 3-in hoses) are 24 ft. length in each tank

Total volume of tank contents are 3000 gallons per HNF-EP-0182, Rev. 175

## Appendix C

### Calculations for Soil Excavation

#### POTENTIAL UNABATED EMISSIONS AND DOSE FOR SOIL EXCAVATION ACTIVITIES HAND DIGGING SOIL EXCAVATION ACTIVITIES FOR C-200 RETRIEVAL

MAXIMUM SOIL EXCAVATED	8,500	FEET^3						
SOIL DENSITY	98	POUNDS/FEET^3						
TOTAL MASS OF SOIL <sup>a</sup> (TMS)	3.78E+08	GRAMS						
MAXIMUM ALPHA READING (MA)	20	CPM						
MAXIMUM BETA/GAMMA READING (MB)	100,000	CPM	1,000,000	dpm/probe*				
RELEASE FRACTION (RF)	1.00E-03							
ASSUMED ISOTOPE	CONVERSION FACTOR (pCi/gram)/cpm (a)	POSSESSION QUANTITY (b) CI	UNABATED RELEASE, CI	OFFSITE DOSE FACTOR, mrem/CI	ONSITE DOSE FACTOR, mrem/CI	UNABATED & Abated DOSE, mrem/yr (d)	UNABATED & Abated DOSE, mrem/yr	% UNABATED DOSE
				OffSite MPR	OnSite MPR	OffSite MPR	OnSite MPR	OffSite MPR
	A	B =A*TMS*MB/1E12	C=B*RF	D	E	F=C*D	G=C*E	H=E/sumE
Sr-90	0.35	1.34E+01	1.34E-02	1.10E-01	9.50E-03	1.47E-03	1.27E-04	25.68%
Am-241	14.20	1.07E-01	1.07E-04	1.30E+01	1.50E+01	1.39E-03	1.61E-03	24.32%
TOTAL		1.35E+01	1.35E-02			5.74E-03	3.47E-03	

**Notes:**

- [a] HNF-2418, Soil Contamination Standards for Protection of Personnel, March 1998, P.D. Rittmann Tables 1 and 4 based on 500 mrem/yr.
- [b] WEIGHT OF SOIL X FIELD INSTRUMENT READING X CONVERSION FACTOR.
- [c] HNF-3602, Rev 1, Calculating Potential-to-Emit Releases and Doses for FEMPs and NOCs. The Offsite Dose Factor is an annual quantity.
- [d] There is no emissions control equipment. Abated and unabated values are equal.  
Source RSR # 221996 (5-28-96) average of values not including  
Grid B. dpm includes a correction factor of 10.  
dpm = cpm\*correction factor  
unabated emissions are multiplied by 2X to increase conservatism

# Appendix D Calculation for Exhauster Operations

Calculated Emissions from C-201 Inventory using Appendix D release fractions													
Total Tank Volume	1.00E+03												
Analyte	Inventory Ci	Release Fraction	Unabated Release Ci	Cap-88 OffSite MPR mrem/Ci	Offsite Unabated Dose mrem/yr	Offsite Abated Dose mrem/yr	Contribution to Unabated Dose %	Contribution to Abated Dose %	Cap-88 OnSite MPR mrem/Ci	Onsite Unabated Dose mrem/yr	Onsite Abated Dose mrem/yr	Contribution to Unabated Dose %	Contribution to Abated Dose %
	A	C	D=A*C	E	F=D*E	G=F/2000 (decon factor) except for gases	K=F/Sum of F	L=G/Sum of G	M	N=D*M	G=F/2000 (decon factor) except for gases	K=F/Sum of F	L=G/Sum of G
3H	9.80E-04	1.00E+00	9.80E-04	2.50E-05	2.45E-08	2.45E-08	0.00%	0.00%	7.10E-06	6.96E-09	6.96E-09	0.00%	0.00%
14C	2.01E-03	1.00E+00	2.01E-03	1.90E-03	3.82E-06	3.82E-06	0.00%	0.75%	1.80E-04	3.62E-07	3.62E-07	0.00%	0.07%
60Co	8.42E-04	1.00E-03	8.42E-07	2.50E-01	2.11E-07	1.05E-10	0.00%	0.00%	3.00E-01	2.53E-07	1.26E-10	0.00%	0.00%
59Ni	7.52E-01	1.00E-03	7.52E-04	3.10E-04	2.33E-07	1.17E-10	0.00%	0.00%	2.90E-04	2.18E-07	1.09E-10	0.00%	0.00%
63Ni	7.00E+01	1.00E-03	7.00E-02	2.60E-04	1.82E-05	9.10E-09	0.00%	0.00%	6.90E-05	4.83E-06	2.42E-09	0.00%	0.00%
79Se	8.79E-04	1.00E-03	8.79E-07	1.30E-01	1.14E-07	5.71E-11	0.00%	0.00%	1.50E-01	1.32E-07	6.59E-11	0.00%	0.00%
90Sr	4.13E+02	1.00E-03	4.13E-01	1.10E-01	4.54E-02	2.27E-05	4.54%	4.46%	9.50E-03	3.92E-03	1.96E-06	0.35%	0.35%
90Y	4.13E+02	1.00E-03	4.13E-01	3.40E-04	1.40E-04	7.02E-08	0.01%	0.01%	2.60E-04	1.07E-04	5.37E-08	0.01%	0.01%
93Zr	3.88E-02	1.00E-03	3.88E-05	1.30E-03	5.04E-08	2.52E-11	0.00%	0.00%	1.30E-03	5.04E-08	2.52E-11	0.00%	0.00%
93mNb	3.45E-02	1.00E-03	3.45E-05	2.10E-03	7.25E-08	3.62E-11	0.00%	0.00%	1.20E-03	4.14E-08	2.07E-11	0.00%	0.00%
99Tc	1.41E-02	1.00E-03	1.41E-05	2.30E-02	3.24E-07	1.62E-10	0.00%	0.00%	1.40E-03	1.97E-08	9.87E-12	0.00%	0.00%
106Ru	1.36E-07	1.00E+00	1.36E-07	2.00E-02	2.72E-09	2.72E-09	0.00%	0.00%	1.90E-02	2.58E-09	2.58E-09	0.00%	0.00%
113mCd	7.20E-02	1.00E-03	7.20E-05	1.30E-01	9.36E-06	4.68E-09	0.00%	0.00%	1.50E-01	1.08E-05	5.40E-09	0.00%	0.00%
126Sn	5.61E-03	1.00E-03	5.61E-06	4.70E-02	2.64E-07	1.32E-10	0.00%	0.00%	4.10E-02	2.30E-07	1.15E-10	0.00%	0.00%
125Sb	1.41E-03	1.00E-03	1.41E-06	2.60E-02	3.67E-08	1.83E-11	0.00%	0.00%	3.30E-02	4.65E-08	2.33E-11	0.00%	0.00%

129I	2.74E-05	1.00E+00	2.74E-05	2.00E-01	5.48E-06	5.48E-06	0.00%	1.08%	2.20E-02	6.03E-07	6.03E-07	0.00%	0.11%
134Cs	7.46E-07	1.00E-03	7.46E-10	1.00E-01	7.46E-11	3.73E-14	0.00%	0.00%	4.70E-02	3.51E-11	1.75E-14	0.00%	0.00%
137Cs	7.87E+01	1.00E-03	7.87E-02	2.40E-01	1.89E-02	9.44E-06	1.89%	1.85%	2.70E-01	2.12E-02	1.06E-05	1.92%	1.91%
137mBa	7.45E+01	1.00E-03	7.45E-02	5.30E-13	3.95E-14	1.97E-17	0.00%	0.00%	1.00E-11	7.45E-13	3.73E-16	0.00%	0.00%
151Sm	3.12E+01	1.00E-03	3.12E-02	7.50E-04	2.34E-05	1.17E-08	0.00%	0.00%	8.40E-04	2.62E-05	1.31E-08	0.00%	0.00%
152Eu	4.05E-01	1.00E-03	4.05E-04	2.40E-01	9.72E-05	4.86E-08	0.01%	0.01%	3.10E-01	1.26E-04	6.28E-08	0.01%	0.01%
154Eu	1.91E-01	1.00E-03	1.91E-04	2.00E-01	3.82E-05	1.91E-08	0.00%	0.00%	2.50E-01	4.78E-05	2.39E-08	0.00%	0.00%
155Eu	1.42E+01	1.00E-03	1.42E-02	8.00E-03	1.14E-04	5.68E-08	0.01%	0.01%	9.80E-03	1.39E-04	6.96E-08	0.01%	0.01%
226Ra	6.52E-05	1.00E-03	6.52E-08	4.60E-01	3.00E-08	1.50E-11	0.00%	0.00%	2.50E-01	1.63E-08	8.15E-12	0.00%	0.00%
228Ra	1.78E-10	1.00E-03	1.78E-13	1.90E-01	3.38E-14	1.69E-17	0.00%	0.00%	7.00E-02	1.25E-14	6.23E-18	0.00%	0.00%
227Ac	2.56E-04	1.00E-03	2.56E-07	1.50E+01	3.84E-06	1.92E-09	0.00%	0.00%	1.80E+01	4.61E-06	2.30E-09	0.00%	0.00%
229Th	6.63E-08	1.00E-03	6.63E-11	1.60E+01	1.06E-09	5.30E-13	0.00%	0.00%	2.00E+01	1.33E-09	6.63E-13	0.00%	0.00%
232Th	4.78E-13	1.00E-03	4.78E-16	9.20E+00	4.40E-15	2.20E-18	0.00%	0.00%	1.20E+01	5.74E-15	2.87E-18	0.00%	0.00%
231Pa	8.65E-06	1.00E-03	8.65E-09	1.20E+01	1.04E-07	5.19E-11	0.00%	0.00%	1.40E+01	1.21E-07	6.06E-11	0.00%	0.00%
232U	4.15E-09	1.00E-03	4.15E-12	1.10E+01	4.57E-11	2.28E-14	0.00%	0.00%	1.30E+01	5.40E-11	2.70E-14	0.00%	0.00%
233U	2.66E-10	1.00E-03	2.66E-13	3.10E+00	8.25E-13	4.12E-16	0.00%	0.00%	3.70E+00	9.84E-13	4.92E-16	0.00%	0.00%
234U	3.75E-04	1.00E-03	3.75E-07	3.10E+00	1.16E-06	5.81E-10	0.00%	0.00%	3.70E+00	1.39E-06	6.94E-10	0.00%	0.00%
235U	1.69E-05	1.00E-03	1.69E-08	3.00E+00	5.07E-08	2.54E-11	0.00%	0.00%	3.50E+00	5.92E-08	2.96E-11	0.00%	0.00%
236U	2.39E-06	1.00E-03	2.39E-09	2.90E+00	6.93E-09	3.47E-12	0.00%	0.00%	3.50E+00	8.37E-09	4.18E-12	0.00%	0.00%
238U	3.80E-04	1.00E-03	3.80E-07	2.80E+00	1.06E-06	5.32E-10	0.00%	0.00%	3.30E+00	1.25E-06	6.27E-10	0.00%	0.00%
237Np	4.28E-05	1.00E-03	4.28E-08	1.20E+01	5.14E-07	2.57E-10	0.00%	0.00%	1.40E+01	5.99E-07	3.00E-10	0.00%	0.00%
238Pu	1.45E+00	1.00E-03	1.45E-03	7.60E+00	1.10E-02	5.51E-06	1.10%	1.08%	8.90E+00	1.29E-02	6.45E-06	1.16%	1.16%
239Pu	6.48E+01	1.00E-03	6.48E-02	8.20E+00	5.31E-01	2.66E-04	53.12%	52.15%	9.50E+00	6.16E-01	3.08E-04	55.55%	55.45%
240Pu	1.07E+01	1.00E-03	1.07E-02	8.20E+00	8.77E-02	4.39E-05	8.77%	8.61%	9.50E+00	1.02E-01	5.08E-05	9.17%	9.16%
241Pu	7.92E+01	1.00E-03	7.92E-02	1.30E-01	1.03E-02	5.15E-06	1.03%	1.01%	1.50E-01	1.19E-02	5.94E-06	1.07%	1.07%
242Pu	5.46E-04	1.00E-03	5.46E-07	7.80E+00	4.26E-06	2.13E-09	0.00%	0.00%	9.10E+00	4.97E-06	2.48E-09	0.00%	0.00%
241Am	2.27E+01	1.00E-03	2.27E-02	1.30E+01	2.95E-01	1.48E-04	29.50%	28.96%	1.50E+01	3.41E-01	1.70E-04	30.72%	30.67%
243Am	5.26E-04	1.00E-03	5.26E-07	1.30E+01	6.84E-06	3.42E-09	0.00%	0.00%	1.50E+01	7.89E-06	3.95E-09	0.00%	0.00%
242Cm	3.41E-02	1.00E-03	3.41E-05	4.10E-01	1.40E-05	6.99E-09	0.00%	0.00%	5.00E-01	1.71E-05	8.53E-09	0.00%	0.00%
243Cm	1.63E-03	1.00E-03	1.63E-06	8.50E+00	1.39E-05	6.93E-09	0.00%	0.00%	1.00E+01	1.63E-05	8.15E-09	0.00%	0.00%
244Cm	7.20E-04	1.00E-03	7.20E-07	6.70E+00	4.82E-06	2.41E-09	0.00%	0.00%	8.00E+00	5.76E-06	2.88E-09	0.00%	0.00%
	1.28E+03			Total	1.00E+00	5.09E-04	100.00%	100.00%		1.11E+00	5.55E-04	100.00%	100.00%

**Appendix D**  
**Calculation for Exhauster Operations continued**

Calculated Emissions from C-202 Inventory using Appendix D release fractions													
Total Tank Volume	1.00E+03												
Analyte	Inventory Ci	Release Fraction	Unabated Release Ci	Cap-88 OffSite MPR mrem/Ci	Offsite Unabated Dose mrem/yr	Offsite Abated Dose mrem/yr	Contribution to Unabated Dose %	Contribution to Abated Dose %	Cap-88 OnSite MPR mrem/Ci	Onsite Unabated Dose mrem/yr	Onsite Abated Dose mrem/yr	Contribution to Unabated Dose %	Contribution to Abated Dose %
	A	C	D=A*C	E	F=D*E	G=F/2000 (decon factor) except for gases	K=F/Sum of F	L=G/Sum of G	M	N=D*M	G=F/2000 (decon factor) except for gases	K=F/Sum of F	L=G/Sum of G
3H	1.02E-03	1.00E+00	1.02E-03	2.50E-05	2.55E-08	2.55E-08	0.00%	0.01%	7.10E-06	7.24E-09	7.24E-09	0.00%	0.00%
14C	2.09E-03	1.00E+00	2.09E-03	1.90E-03	3.97E-06	3.97E-06	0.00%	1.38%	1.80E-04	3.76E-07	3.76E-07	0.00%	0.13%
60Co	8.77E-04	1.00E-03	8.77E-07	2.50E-01	2.19E-07	1.10E-10	0.00%	0.00%	3.00E-01	2.63E-07	1.32E-10	0.00%	0.00%
59Ni	7.84E-01	1.00E-03	7.84E-04	3.10E-04	2.43E-07	1.22E-10	0.00%	0.00%	2.90E-04	2.27E-07	1.14E-10	0.00%	0.00%
63Ni	7.29E+01	1.00E-03	7.29E-02	2.60E-04	1.90E-05	9.48E-09	0.00%	0.00%	6.90E-05	5.03E-06	2.52E-09	0.00%	0.00%
79Se	9.16E-04	1.00E-03	9.16E-07	1.30E-01	1.19E-07	5.95E-11	0.00%	0.00%	1.50E-01	1.37E-07	6.87E-11	0.00%	0.00%
90Sr	4.31E+02	1.00E-03	4.31E-01	1.10E-01	4.74E-02	2.37E-05	8.51%	8.22%	9.50E-03	4.09E-03	2.05E-06	0.69%	0.69%
90Y	4.31E+02	1.00E-03	4.31E-01	3.40E-04	1.47E-04	7.33E-08	0.03%	0.03%	2.60E-04	1.12E-04	5.60E-08	0.02%	0.02%
93Zr	4.04E-02	1.00E-03	4.04E-05	1.30E-03	5.25E-08	2.63E-11	0.00%	0.00%	1.30E-03	5.25E-08	2.63E-11	0.00%	0.00%
93mNb	3.59E-02	1.00E-03	3.59E-05	2.10E-03	7.54E-08	3.77E-11	0.00%	0.00%	1.20E-03	4.31E-08	2.15E-11	0.00%	0.00%
99Tc	1.47E-02	1.00E-03	1.47E-05	2.30E-02	3.38E-07	1.69E-10	0.00%	0.00%	1.40E-03	2.06E-08	1.03E-11	0.00%	0.00%
106Ru	1.42E-07	1.00E+00	1.42E-07	2.00E-02	2.84E-09	2.84E-09	0.00%	0.00%	1.90E-02	2.70E-09	2.70E-09	0.00%	0.00%
113mCd	7.50E-02	1.00E-03	7.50E-05	1.30E-01	9.75E-06	4.88E-09	0.00%	0.00%	1.50E-01	1.13E-05	5.63E-09	0.00%	0.00%
126Sn	5.85E-03	1.00E-03	5.85E-06	4.70E-02	2.75E-07	1.37E-10	0.00%	0.00%	4.10E-02	2.40E-07	1.20E-10	0.00%	0.00%
125Sb	1.47E-03	1.00E-03	1.47E-06	2.60E-02	3.82E-08	1.91E-11	0.00%	0.00%	3.30E-02	4.85E-08	2.43E-11	0.00%	0.00%
129I	2.85E-05	1.00E+00	2.85E-05	2.00E-01	5.70E-06	5.70E-06	0.00%	1.98%	2.20E-02	6.27E-07	6.27E-07	0.00%	0.21%

134Cs	7.78E-07	1.00E-03	7.78E-10	1.00E-01	7.78E-11	3.89E-14	0.00%	0.00%	4.70E-02	3.66E-11	1.83E-14	0.00%	0.00%
137Cs	8.22E+01	1.00E-03	8.22E-02	2.40E-01	1.97E-02	9.86E-06	3.54%	3.42%	2.70E-01	2.22E-02	1.11E-05	3.74%	3.73%
137mBa	7.77E+01	1.00E-03	7.77E-02	5.30E-13	4.12E-14	2.06E-17	0.00%	0.00%	1.00E-11	7.77E-13	3.89E-16	0.00%	0.00%
151Sm	3.25E+01	1.00E-03	3.25E-02	7.50E-04	2.44E-05	1.22E-08	0.00%	0.00%	8.40E-04	2.73E-05	1.37E-08	0.00%	0.00%
152Eu	4.22E-01	1.00E-03	4.22E-04	2.40E-01	1.01E-04	5.06E-08	0.02%	0.02%	3.10E-01	1.31E-04	6.54E-08	0.02%	0.02%
154Eu	1.99E-01	1.00E-03	1.99E-04	2.00E-01	3.98E-05	1.99E-08	0.01%	0.01%	2.50E-01	4.98E-05	2.49E-08	0.01%	0.01%
155Eu	1.48E+01	1.00E-03	1.48E-02	8.00E-03	1.18E-04	5.92E-08	0.02%	0.02%	9.80E-03	1.45E-04	7.25E-08	0.02%	0.02%
226Ra	6.79E-05	1.00E-03	6.79E-08	4.60E-01	3.12E-08	1.56E-11	0.00%	0.00%	2.50E-01	1.70E-08	8.49E-12	0.00%	0.00%
228Ra	1.85E-10	1.00E-03	1.85E-13	1.90E-01	3.52E-14	1.76E-17	0.00%	0.00%	7.00E-02	1.30E-14	6.48E-18	0.00%	0.00%
227Ac	2.66E-04	1.00E-03	2.66E-07	1.50E+01	3.99E-06	2.00E-09	0.00%	0.00%	1.80E+01	4.79E-06	2.39E-09	0.00%	0.00%
229Th	6.91E-08	1.00E-03	6.91E-11	1.60E+01	1.11E-09	5.53E-13	0.00%	0.00%	2.00E+01	1.38E-09	6.91E-13	0.00%	0.00%
232Th	4.98E-13	1.00E-03	4.98E-16	9.20E+00	4.58E-15	2.29E-18	0.00%	0.00%	1.20E+01	5.98E-15	2.99E-18	0.00%	0.00%
231Pa	9.01E-06	1.00E-03	9.01E-09	1.20E+01	1.08E-07	5.41E-11	0.00%	0.00%	1.40E+01	1.26E-07	6.31E-11	0.00%	0.00%
232U	2.60E-08	1.00E-03	2.60E-11	1.10E+01	2.86E-10	1.43E-13	0.00%	0.00%	1.30E+01	3.38E-10	1.69E-13	0.00%	0.00%
233U	7.31E-10	1.00E-03	7.31E-13	3.10E+00	2.27E-12	1.13E-15	0.00%	0.00%	3.70E+00	2.70E-12	1.35E-15	0.00%	0.00%
234U	3.99E-04	1.00E-03	3.99E-07	3.10E+00	1.24E-06	6.18E-10	0.00%	0.00%	3.70E+00	1.48E-06	7.38E-10	0.00%	0.00%
235U	1.68E-05	1.00E-03	1.68E-08	3.00E+00	5.04E-08	2.52E-11	0.00%	0.00%	3.50E+00	5.88E-08	2.94E-11	0.00%	0.00%
236U	9.28E-06	1.00E-03	9.28E-09	2.90E+00	2.69E-08	1.35E-11	0.00%	0.00%	3.50E+00	3.25E-08	1.62E-11	0.00%	0.00%
238U	3.96E-04	1.00E-03	3.96E-07	2.80E+00	1.11E-06	5.54E-10	0.00%	0.00%	3.30E+00	1.31E-06	6.53E-10	0.00%	0.00%
237Np	4.46E-05	1.00E-03	4.46E-08	1.20E+01	5.35E-07	2.68E-10	0.00%	0.00%	1.40E+01	6.24E-07	3.12E-10	0.00%	0.00%
238Pu	7.62E-01	1.00E-03	7.62E-04	7.60E+00	5.79E-03	2.90E-06	1.04%	1.00%	8.90E+00	6.78E-03	3.39E-06	1.14%	1.14%
239Pu	3.39E+01	1.00E-03	3.39E-02	8.20E+00	2.78E-01	1.39E-04	49.89%	48.21%	9.50E+00	3.22E-01	1.61E-04	54.28%	54.10%
240Pu	5.57E+00	1.00E-03	5.57E-03	8.20E+00	4.57E-02	2.28E-05	8.20%	7.92%	9.50E+00	5.29E-02	2.65E-05	8.92%	8.89%
241Pu	4.14E+01	1.00E-03	4.14E-02	1.30E-01	5.38E-03	2.69E-06	0.97%	0.93%	1.50E-01	6.21E-03	3.11E-06	1.05%	1.04%
242Pu	2.85E-04	1.00E-03	2.85E-07	7.80E+00	2.22E-06	1.11E-09	0.00%	0.00%	9.10E+00	2.59E-06	1.30E-09	0.00%	0.00%
241Am	1.19E+01	1.00E-03	1.19E-02	1.30E+01	1.55E-01	7.74E-05	27.77%	26.83%	1.50E+01	1.79E-01	8.93E-05	30.09%	29.99%
243Am	2.75E-04	1.00E-03	2.75E-07	1.30E+01	3.58E-06	1.79E-09	0.00%	0.00%	1.50E+01	4.13E-06	2.06E-09	0.00%	0.00%
242Cm	1.78E-02	1.00E-03	1.78E-05	4.10E-01	7.30E-06	3.65E-09	0.00%	0.00%	5.00E-01	8.90E-06	4.45E-09	0.00%	0.00%
243Cm	8.52E-04	1.00E-03	8.52E-07	8.50E+00	7.24E-06	3.62E-09	0.00%	0.00%	1.00E+01	8.52E-06	4.26E-09	0.00%	0.00%
244Cm	3.76E-04	1.00E-03	3.76E-07	6.70E+00	2.52E-06	1.26E-09	0.00%	0.00%	8.00E+00	3.01E-06	1.50E-09	0.00%	0.00%
	1.24E+03			Total	5.57E-01	2.88E-04	100.00%	100.00%		5.93E-01	2.98E-04	100.00%	100.00%

## Appendix D

### Calculation for Exhauster Operations continued

Calculated Emissions from C-203 Inventory using Appendix D release fractions													
Total Tank Volume	3.00E+03												
Analyte	Inventory Ci	Release Fraction	Unabated Release Ci	Cap-88 OffSite MPR mrem/Ci	Offsite Unabated Dose mrem/yr	Offsite Abated Dose mrem/yr	Contribution to Unabated Dose %	Contribution to Abated Dose %	Cap-88 OnSite MPR mrem/Ci	Onsite Unabated Dose mrem/yr	Onsite Abated Dose mrem/yr	Contribution to Unabated Dose %	Contribution to Abated Dose %
	A	C	D=A*C	E	F=D*E	G=F/2000 (decon factor) except for gases	K=F/Sum of F	L=G/Sum of G	M	N=D*M	G=F/2000 (decon factor) except for gases	K=F/Sum of F	L=G/Sum of G
3H	1.95E-03	1.00E+00	1.95E-03	2.50E-05	4.88E-08	4.88E-08	0.00%	0.02%	7.10E-06	1.38E-08	1.38E-08	0.00%	0.01%
14C	4.00E-03	1.00E+00	4.00E-03	1.90E-03	7.60E-06	7.60E-06	0.00%	3.69%	1.80E-04	7.20E-07	7.20E-07	0.00%	0.43%
60Co	1.68E-03	1.00E-03	1.68E-06	2.50E-01	4.20E-07	2.10E-10	0.00%	0.00%	3.00E-01	5.04E-07	2.52E-10	0.00%	0.00%
59Ni	1.50E+00	1.00E-03	1.50E-03	3.10E-04	4.65E-07	2.33E-10	0.00%	0.00%	2.90E-04	4.35E-07	2.18E-10	0.00%	0.00%
63Ni	1.40E+02	1.00E-03	1.40E-01	2.60E-04	3.64E-05	1.82E-08	0.01%	0.01%	6.90E-05	9.66E-06	4.83E-09	0.00%	0.00%
79Se	1.75E-03	1.00E-03	1.75E-06	1.30E-01	2.28E-07	1.14E-10	0.00%	0.00%	1.50E-01	2.63E-07	1.31E-10	0.00%	0.00%
90Sr	8.23E+02	1.00E-03	8.23E-01	1.10E-01	9.05E-02	4.53E-05	24.18%	22.00%	9.50E-03	7.82E-03	3.91E-06	2.33%	2.31%
90Y	8.23E+02	1.00E-03	8.23E-01	3.40E-04	2.80E-04	1.40E-07	0.07%	0.07%	2.60E-04	2.14E-04	1.07E-07	0.06%	0.06%
93Zr	7.73E-02	1.00E-03	7.73E-05	1.30E-03	1.00E-07	5.02E-11	0.00%	0.00%	1.30E-03	1.00E-07	5.02E-11	0.00%	0.00%
93mNb	6.88E-02	1.00E-03	6.88E-05	2.10E-03	1.44E-07	7.22E-11	0.00%	0.00%	1.20E-03	8.26E-08	4.13E-11	0.00%	0.00%
99Tc	2.82E-02	1.00E-03	2.82E-05	2.30E-02	6.49E-07	3.24E-10	0.00%	0.00%	1.40E-03	3.95E-08	1.97E-11	0.00%	0.00%
106Ru	2.71E-07	1.00E+00	2.71E-07	2.00E-02	5.42E-09	5.42E-09	0.00%	0.00%	1.90E-02	5.15E-09	5.15E-09	0.00%	0.00%
113mCd	1.44E-01	1.00E-03	1.44E-04	1.30E-01	1.87E-05	9.36E-09	0.01%	0.00%	1.50E-01	2.16E-05	1.08E-08	0.01%	0.01%
126Sn	1.12E-02	1.00E-03	1.12E-05	4.70E-02	5.26E-07	2.63E-10	0.00%	0.00%	4.10E-02	4.59E-07	2.30E-10	0.00%	0.00%
125Sb	2.81E-03	1.00E-03	2.81E-06	2.60E-02	7.31E-08	3.65E-11	0.00%	0.00%	3.30E-02	9.27E-08	4.64E-11	0.00%	0.00%
129I	5.46E-05	1.00E+00	5.46E-05	2.00E-01	1.09E-05	1.09E-05	0.00%	5.31%	2.20E-02	1.20E-06	1.20E-06	0.00%	0.71%

134Cs	1.49E-06	1.00E-03	1.49E-09	1.00E-01	1.49E-10	7.45E-14	0.00%	0.00%	4.70E-02	7.00E-11	3.50E-14	0.00%	0.00%
137Cs	1.57E+02	1.00E-03	1.57E-01	2.40E-01	3.77E-02	1.88E-05	10.07%	9.16%	2.70E-01	4.24E-02	2.12E-05	12.66%	12.51%
137mBa	1.48E+02	1.00E-03	1.48E-01	5.30E-13	7.84E-14	3.92E-17	0.00%	0.00%	1.00E-11	1.48E-12	7.40E-16	0.00%	0.00%
151Sm	6.22E+01	1.00E-03	6.22E-02	7.50E-04	4.67E-05	2.33E-08	0.01%	0.01%	8.40E-04	5.22E-05	2.61E-08	0.02%	0.02%
152Eu	8.08E-01	1.00E-03	8.08E-04	2.40E-01	1.94E-04	9.70E-08	0.05%	0.05%	3.10E-01	2.50E-04	1.25E-07	0.07%	0.07%
154Eu	3.80E-01	1.00E-03	3.80E-04	2.00E-01	7.60E-05	3.80E-08	0.02%	0.02%	2.50E-01	9.50E-05	4.75E-08	0.03%	0.03%
155Eu	2.83E+01	1.00E-03	2.83E-02	8.00E-03	2.26E-04	1.13E-07	0.06%	0.06%	9.80E-03	2.77E-04	1.39E-07	0.08%	0.08%
226Ra	1.30E-04	1.00E-03	1.30E-07	4.60E-01	5.98E-08	2.99E-11	0.00%	0.00%	2.50E-01	3.25E-08	1.63E-11	0.00%	0.00%
228Ra	3.54E-10	1.00E-03	3.54E-13	1.90E-01	6.73E-14	3.36E-17	0.00%	0.00%	7.00E-02	2.48E-14	1.24E-17	0.00%	0.00%
227Ac	5.10E-04	1.00E-03	5.10E-07	1.50E+01	7.65E-06	3.83E-09	0.00%	0.00%	1.80E+01	9.18E-06	4.59E-09	0.00%	0.00%
229Th	1.32E-07	1.00E-03	1.32E-10	1.60E+01	2.11E-09	1.06E-12	0.00%	0.00%	2.00E+01	2.64E-09	1.32E-12	0.00%	0.00%
232Th	9.54E-13	1.00E-03	9.54E-16	9.20E+00	8.78E-15	4.39E-18	0.00%	0.00%	1.20E+01	1.14E-14	5.72E-18	0.00%	0.00%
231Pa	1.73E-05	1.00E-03	1.73E-08	1.20E+01	2.08E-07	1.04E-10	0.00%	0.00%	1.40E+01	2.42E-07	1.21E-10	0.00%	0.00%
232U	8.27E-09	1.00E-03	8.27E-12	1.10E+01	9.10E-11	4.55E-14	0.00%	0.00%	1.30E+01	1.08E-10	5.38E-14	0.00%	0.00%
233U	5.30E-10	1.00E-03	5.30E-13	3.10E+00	1.64E-12	8.22E-16	0.00%	0.00%	3.70E+00	1.96E-12	9.81E-16	0.00%	0.00%
234U	7.47E-04	1.00E-03	7.47E-07	3.10E+00	2.32E-06	1.16E-09	0.00%	0.00%	3.70E+00	2.76E-06	1.38E-09	0.00%	0.00%
235U	3.36E-05	1.00E-03	3.36E-08	3.00E+00	1.01E-07	5.04E-11	0.00%	0.00%	3.50E+00	1.18E-07	5.88E-11	0.00%	0.00%
236U	4.77E-06	1.00E-03	4.77E-09	2.90E+00	1.38E-08	6.92E-12	0.00%	0.00%	3.50E+00	1.67E-08	8.35E-12	0.00%	0.00%
238U	7.56E-04	1.00E-03	7.56E-07	2.80E+00	2.12E-06	1.06E-09	0.00%	0.00%	3.30E+00	2.49E-06	1.25E-09	0.00%	0.00%
237Np	8.53E-05	1.00E-03	8.53E-08	1.20E+01	1.02E-06	5.12E-10	0.00%	0.00%	1.40E+01	1.19E-06	5.97E-10	0.00%	0.00%
238Pu	3.81E-01	1.00E-03	3.81E-04	7.60E+00	2.90E-03	1.45E-06	0.77%	0.70%	8.90E+00	3.39E-03	1.70E-06	1.01%	1.00%
239Pu	1.70E+01	1.00E-03	1.70E-02	8.20E+00	1.39E-01	6.97E-05	37.24%	33.88%	9.50E+00	1.62E-01	8.08E-05	48.22%	47.67%
240Pu	2.79E+00	1.00E-03	2.79E-03	8.20E+00	2.29E-02	1.14E-05	6.11%	5.56%	9.50E+00	2.65E-02	1.33E-05	7.91%	7.82%
241Pu	2.07E+01	1.00E-03	2.07E-02	1.30E-01	2.69E-03	1.35E-06	0.72%	0.65%	1.50E-01	3.11E-03	1.55E-06	0.93%	0.92%
242Pu	1.43E-04	1.00E-03	1.43E-07	7.80E+00	1.12E-06	5.58E-10	0.00%	0.00%	9.10E+00	1.30E-06	6.51E-10	0.00%	0.00%
241Am	5.95E+00	1.00E-03	5.95E-03	1.30E+01	7.74E-02	3.87E-05	20.66%	18.80%	1.50E+01	8.93E-02	4.46E-05	26.65%	26.34%
243Am	1.37E-04	1.00E-03	1.37E-07	1.30E+01	1.78E-06	8.91E-10	0.00%	0.00%	1.50E+01	2.06E-06	1.03E-09	0.00%	0.00%
242Cm	8.93E-03	1.00E-03	8.93E-06	4.10E-01	3.66E-06	1.83E-09	0.00%	0.00%	5.00E-01	4.47E-06	2.23E-09	0.00%	0.00%
243Cm	4.26E-04	1.00E-03	4.26E-07	8.50E+00	3.62E-06	1.81E-09	0.00%	0.00%	1.00E+01	4.26E-06	2.13E-09	0.00%	0.00%
244Cm	1.88E-04	1.00E-03	1.88E-07	6.70E+00	1.26E-06	6.30E-10	0.00%	0.00%	8.00E+00	1.50E-06	7.52E-10	0.00%	0.00%
	2.23E+03			Total	3.74E-01	2.06E-04	100.00%	100.00%		3.35E-01	1.69E-04	100.00%	100.00%

**Appendix D**  
**Calculation for Exhauster Operations continued**

Calculated Emissions from C-204 Inventory using Appendix D release fractions													
Total Tank Volume	3.00E+03												
Analyte	Inventory Ci	Release Fraction	Unabated Release Ci	Cap-88 OffSite MPR mrem/Ci	Offsite Unabated Dose mrem/yr	Offsite Abated Dose mrem/yr	Contribution to Unabated Dose %	Contribution to Abated Dose %	Cap-88 OnSite MPR mrem/Ci	Onsite Unabated Dose mrem/yr	Onsite Abated Dose mrem/yr	Contribution to Unabated Dose %	Contribution to Abated Dose %
	A	C	D=A*C	E	F=D*E	G=F/2000 (decon factor) except for gases	K=F/Sum of F	L=G/Sum of G	M	N=D*M	G=F/2000 (decon factor) except for gases	K=F/Sum of F	L=G/Sum of G
3H	1.26E-03	1.00E+00	1.26E-03	2.50E-05	3.15E-08	3.15E-08	0.00%	0.06%	7.10E-06	8.95E-09	8.95E-09	0.00%	0.04%
14C	2.58E-03	1.00E+00	2.58E-03	1.90E-03	4.90E-06	4.90E-06	0.01%	8.73%	1.80E-04	4.64E-07	4.64E-07	0.00%	2.25%
60Co	1.08E-03	1.00E-03	1.08E-06	2.50E-01	2.70E-07	1.35E-10	0.00%	0.00%	3.00E-01	3.24E-07	1.62E-10	0.00%	0.00%
59Ni	9.66E-01	1.00E-03	9.66E-04	3.10E-04	2.99E-07	1.50E-10	0.00%	0.00%	2.90E-04	2.80E-07	1.40E-10	0.00%	0.00%
63Ni	8.99E+01	1.00E-03	8.99E-02	2.60E-04	2.34E-05	1.17E-08	0.03%	0.02%	6.90E-05	6.20E-06	3.10E-09	0.02%	0.02%
79Se	1.13E-03	1.00E-03	1.13E-06	1.30E-01	1.47E-07	7.35E-11	0.00%	0.00%	1.50E-01	1.70E-07	8.48E-11	0.00%	0.00%
90Sr	5.32E+02	1.00E-03	5.32E-01	1.10E-01	5.85E-02	2.93E-05	66.24%	52.12%	9.50E-03	5.05E-03	2.53E-06	13.05%	12.26%
90Y	5.32E+02	1.00E-03	5.32E-01	3.40E-04	1.81E-04	9.04E-08	0.20%	0.16%	2.60E-04	1.38E-04	6.92E-08	0.36%	0.34%
93Zr	4.98E-02	1.00E-03	4.98E-05	1.30E-03	6.47E-08	3.24E-11	0.00%	0.00%	1.30E-03	6.47E-08	3.24E-11	0.00%	0.00%
93mNb	4.43E-02	1.00E-03	4.43E-05	2.10E-03	9.30E-08	4.65E-11	0.00%	0.00%	1.20E-03	5.32E-08	2.66E-11	0.00%	0.00%
99Tc	1.81E-02	1.00E-03	1.81E-05	2.30E-02	4.16E-07	2.08E-10	0.00%	0.00%	1.40E-03	2.53E-08	1.27E-11	0.00%	0.00%
106Ru	1.75E-07	1.00E+00	1.75E-07	2.00E-02	3.50E-09	3.50E-09	0.00%	0.01%	1.90E-02	3.33E-09	3.33E-09	0.00%	0.02%

113mCd	9.24E-02	1.00E-03	9.24E-05	1.30E-01	1.20E-05	6.01E-09	0.01%	0.01%	1.50E-01	1.39E-05	6.93E-09	0.04%	0.03%
126Sn	7.21E-03	1.00E-03	7.21E-06	4.70E-02	3.39E-07	1.69E-10	0.00%	0.00%	4.10E-02	2.96E-07	1.48E-10	0.00%	0.00%
125Sb	1.81E-03	1.00E-03	1.81E-06	2.60E-02	4.71E-08	2.35E-11	0.00%	0.00%	3.30E-02	5.97E-08	2.99E-11	0.00%	0.00%
129I	3.52E-05	1.00E+00	3.52E-05	2.00E-01	7.04E-06	7.04E-06	0.01%	12.54%	2.20E-02	7.74E-07	7.74E-07	0.00%	3.76%
134Cs	9.59E-07	1.00E-03	9.59E-10	1.00E-01	9.59E-11	4.80E-14	0.00%	0.00%	4.70E-02	4.51E-11	2.25E-14	0.00%	0.00%
137Cs	1.01E+02	1.00E-03	1.01E-01	2.40E-01	2.42E-02	1.21E-05	27.44%	21.59%	2.70E-01	2.73E-02	1.36E-05	70.44%	66.16%
137mBa	9.59E+01	1.00E-03	9.59E-02	5.30E-13	5.08E-14	2.54E-17	0.00%	0.00%	1.00E-11	9.59E-13	4.80E-16	0.00%	0.00%
151Sm	4.01E+01	1.00E-03	4.01E-02	7.50E-04	3.01E-05	1.50E-08	0.03%	0.03%	8.40E-04	3.37E-05	1.68E-08	0.09%	0.08%
152Eu	5.20E-01	1.00E-03	5.20E-04	2.40E-01	1.25E-04	6.24E-08	0.14%	0.11%	3.10E-01	1.61E-04	8.06E-08	0.42%	0.39%
154Eu	2.45E-01	1.00E-03	2.45E-04	2.00E-01	4.90E-05	2.45E-08	0.06%	0.04%	2.50E-01	6.13E-05	3.06E-08	0.16%	0.15%
155Eu	1.82E+01	1.00E-03	1.82E-02	8.00E-03	1.46E-04	7.28E-08	0.16%	0.13%	9.80E-03	1.78E-04	8.92E-08	0.46%	0.43%
226Ra	8.37E-05	1.00E-03	8.37E-08	4.60E-01	3.85E-08	1.93E-11	0.00%	0.00%	2.50E-01	2.09E-08	1.05E-11	0.00%	0.00%
228Ra	2.28E-10	1.00E-03	2.28E-13	1.90E-01	4.33E-14	2.17E-17	0.00%	0.00%	7.00E-02	1.60E-14	7.98E-18	0.00%	0.00%
227Ac	3.28E-04	1.00E-03	3.28E-07	1.50E+01	4.92E-06	2.46E-09	0.01%	0.00%	1.80E+01	5.90E-06	2.95E-09	0.02%	0.01%
229Th	8.52E-08	1.00E-03	8.52E-11	1.60E+01	1.36E-09	6.82E-13	0.00%	0.00%	2.00E+01	1.70E-09	8.52E-13	0.00%	0.00%
232Th	6.14E-13	1.00E-03	6.14E-16	9.20E+00	5.65E-15	2.82E-18	0.00%	0.00%	1.20E+01	7.37E-15	3.68E-18	0.00%	0.00%
231Pa	1.11E-05	1.00E-03	1.11E-08	1.20E+01	1.33E-07	6.66E-11	0.00%	0.00%	1.40E+01	1.55E-07	7.77E-11	0.00%	0.00%
232U	5.35E-09	1.00E-03	5.35E-12	1.10E+01	5.89E-11	2.94E-14	0.00%	0.00%	1.30E+01	6.96E-11	3.48E-14	0.00%	0.00%
233U	3.42E-10	1.00E-03	3.42E-13	3.10E+00	1.06E-12	5.30E-16	0.00%	0.00%	3.70E+00	1.27E-12	6.33E-16	0.00%	0.00%
234U	4.82E-04	1.00E-03	4.82E-07	3.10E+00	1.49E-06	7.47E-10	0.00%	0.00%	3.70E+00	1.78E-06	8.92E-10	0.00%	0.00%
235U	2.17E-05	1.00E-03	2.17E-08	3.00E+00	6.51E-08	3.26E-11	0.00%	0.00%	3.50E+00	7.60E-08	3.80E-11	0.00%	0.00%
236U	3.08E-06	1.00E-03	3.08E-09	2.90E+00	8.93E-09	4.47E-12	0.00%	0.00%	3.50E+00	1.08E-08	5.39E-12	0.00%	0.00%
238U	4.89E-04	1.00E-03	4.89E-07	2.80E+00	1.37E-06	6.85E-10	0.00%	0.00%	3.30E+00	1.61E-06	8.07E-10	0.00%	0.00%
237Np	5.49E-05	1.00E-03	5.49E-08	1.20E+01	6.59E-07	3.29E-10	0.00%	0.00%	1.40E+01	7.69E-07	3.84E-10	0.00%	0.00%
238Pu	7.76E-03	1.00E-03	7.76E-06	7.60E+00	5.90E-05	2.95E-08	0.07%	0.05%	8.90E+00	6.91E-05	3.45E-08	0.18%	0.17%
239Pu	3.47E-01	1.00E-03	3.47E-04	8.20E+00	2.85E-03	1.42E-06	3.22%	2.53%	9.50E+00	3.30E-03	1.65E-06	8.51%	8.00%
240Pu	5.69E-02	1.00E-03	5.69E-05	8.20E+00	4.67E-04	2.33E-07	0.53%	0.42%	9.50E+00	5.41E-04	2.70E-07	1.40%	1.31%
241Pu	4.23E-01	1.00E-03	4.23E-04	1.30E-01	5.50E-05	2.75E-08	0.06%	0.05%	1.50E-01	6.35E-05	3.17E-08	0.16%	0.15%
242Pu	2.92E-06	1.00E-03	2.92E-09	7.80E+00	2.28E-08	1.14E-11	0.00%	0.00%	9.10E+00	2.66E-08	1.33E-11	0.00%	0.00%
241Am	1.21E-01	1.00E-03	1.21E-04	1.30E+01	1.57E-03	7.87E-07	1.78%	1.40%	1.50E+01	1.82E-03	9.08E-07	4.69%	4.40%
243Am	2.80E-06	1.00E-03	2.80E-09	1.30E+01	3.64E-08	1.82E-11	0.00%	0.00%	1.50E+01	4.20E-08	2.10E-11	0.00%	0.00%
242Cm	1.81E-04	1.00E-03	1.81E-07	4.10E-01	7.42E-08	3.71E-11	0.00%	0.00%	5.00E-01	9.05E-08	4.53E-11	0.00%	0.00%

243Cm	8.70E-06	1.00E-03	8.70E-09	8.50E+00	7.40E-08	3.70E-11	0.00%	0.00%	1.00E+01	8.70E-08	4.35E-11	0.00%	0.00%
244Cm	3.84E-06	1.00E-03	3.84E-09	6.70E+00	2.57E-08	1.29E-11	0.00%	0.00%	8.00E+00	3.07E-08	1.54E-11	0.00%	0.00%
	1.41E+03			Total	8.83E-02	5.61E-05	100.00%	100.00%		3.87E-02	2.06E-05	100.00%	100.00%

## Appendix E

Summary of Dose for C-201/202/203/204 Tanks

Retrieval & Equipment Removal

C-203 and C-204 offsite receptor

C-201 and C-202 onsite receptor

	Offsite Unabated Dose mrem/yr	Offsite Abated Dose mrem/yr	Contribution to Unabated Dose %	Contribution to Abated Dose %	Onsite Unabated Dose mrem/yr	Onsite Abated Dose mrem/yr	Contribution to Unabated Dose %	Contribution to Abated Dose %
		C=B/2000 (decon factor) except for gases, pit openings, soil excavation	D=B/Sum of B	E=C/Sum of C		G=F/2000 (decon factor) except for gases, pit openings, soil excavation	D=B/Sum of B	E=C/Sum of C
3H	8.04E-08	8.04E-08	0.00%	0.00%	1.43E-08	1.43E-08	0.00%	0.00%
14C	1.25E-05	1.25E-05	0.00%	0.30%	7.42E-07	7.42E-07	0.00%	0.01%
60Co	6.92E-07	1.97E-09	0.00%	0.00%	5.19E-07	3.10E-09	0.00%	0.00%
59Ni	7.66E-07	2.18E-09	0.00%	0.00%	4.48E-07	2.67E-09	0.00%	0.00%
63Ni	5.99E-05	1.70E-07	0.01%	0.00%	9.91E-06	5.92E-08	0.00%	0.00%
79Se	3.75E-07	1.07E-09	0.00%	0.00%	2.71E-07	1.62E-09	0.00%	0.00%
90Sr	1.51E-01	1.94E-03	32.35%	46.94%	8.06E-03	4.81E-05	0.47%	0.47%
90Y	4.62E-04	1.31E-06	0.10%	0.03%	2.21E-04	1.32E-06	0.01%	0.01%
93Zr	1.66E-07	4.71E-10	0.00%	0.00%	1.04E-07	6.18E-10	0.00%	0.00%
93mNb	2.38E-07	6.77E-10	0.00%	0.00%	8.49E-08	5.07E-10	0.00%	0.00%
99Tc	1.07E-06	3.03E-09	0.00%	0.00%	4.05E-08	2.42E-10	0.00%	0.00%
106Ru	8.94E-09	8.94E-09	0.00%	0.00%	5.31E-09	5.31E-09	0.00%	0.00%
113mCd	3.08E-05	8.75E-08	0.01%	0.00%	2.22E-05	1.32E-07	0.00%	0.00%
126Sn	8.67E-07	2.47E-09	0.00%	0.00%	4.72E-07	2.82E-09	0.00%	0.00%
125Sb	1.20E-07	3.42E-10	0.00%	0.00%	9.56E-08	5.71E-10	0.00%	0.00%
129I	1.80E-05	1.80E-05	0.00%	0.43%	1.24E-06	1.24E-06	0.00%	0.01%
134Cs	2.45E-10	6.98E-13	0.00%	0.00%	7.20E-11	4.30E-13	0.00%	0.00%
137Cs	6.21E-02	1.76E-04	13.30%	4.26%	4.37E-02	2.61E-04	2.55%	2.55%
137mBa	1.30E-13	3.69E-16	0.00%	0.00%	1.53E-12	9.14E-15	0.00%	0.00%
151Sm	7.69E-05	2.19E-07	0.02%	0.01%	5.38E-05	3.21E-07	0.00%	0.00%
152Eu	3.19E-04	9.08E-07	0.07%	0.02%	2.58E-04	1.54E-06	0.02%	0.02%
154Eu	1.25E-04	3.56E-07	0.03%	0.01%	9.80E-05	5.85E-07	0.01%	0.01%
155Eu	3.73E-04	1.06E-06	0.08%	0.03%	2.86E-04	1.71E-06	0.02%	0.02%
226Ra	9.85E-08	2.80E-10	0.00%	0.00%	3.35E-08	2.00E-10	0.00%	0.00%
228Ra	1.11E-13	3.15E-16	0.00%	0.00%	2.55E-14	1.53E-16	0.00%	0.00%
227Ac	1.26E-05	3.58E-08	0.00%	0.00%	9.45E-06	5.64E-08	0.00%	0.00%
229Th	3.48E-09	9.91E-12	0.00%	0.00%	2.72E-09	1.63E-11	0.00%	0.00%
232Th	1.45E-14	4.11E-17	0.00%	0.00%	1.18E-14	7.03E-17	0.00%	0.00%
231Pa	3.42E-07	9.71E-10	0.00%	0.00%	2.49E-07	1.48E-09	0.00%	0.00%
232U	1.50E-10	4.27E-13	0.00%	0.00%	3.94E-10	2.35E-12	0.00%	0.00%
233U	2.71E-12	7.71E-15	0.00%	0.00%	3.71E-12	2.21E-14	0.00%	0.00%
234U	3.82E-06	1.09E-08	0.00%	0.00%	2.88E-06	1.72E-08	0.00%	0.00%
235U	1.66E-07	4.73E-10	0.00%	0.00%	1.19E-07	7.08E-10	0.00%	0.00%
236U	2.28E-08	6.49E-11	0.00%	0.00%	4.11E-08	2.45E-10	0.00%	0.00%

238U	3.49E-06	9.94E-09	0.00%	0.00%	2.57E-06	1.54E-08	0.00%	0.00%
237Np	1.69E-06	4.79E-09	0.00%	0.00%	1.23E-06	7.35E-09	0.00%	0.00%
238Pu	2.96E-03	6.98E-06	0.63%	0.17%	1.98E-02	1.18E-04	1.16%	1.16%
239Pu	1.43E-01	3.36E-04	30.54%	8.11%	9.43E-01	5.63E-03	55.11%	55.10%
240Pu	2.34E-02	5.51E-05	5.01%	1.33%	1.55E-01	9.28E-04	9.08%	9.08%
241Pu	2.75E-03	6.48E-06	0.59%	0.16%	1.82E-02	1.09E-04	1.06%	1.06%
242Pu	1.14E-06	2.69E-09	0.00%	0.00%	7.60E-06	4.54E-08	0.00%	0.00%
241Am	8.05E-02	1.58E-03	17.25%	38.19%	5.22E-01	3.12E-03	30.50%	30.50%
243Am	1.82E-06	4.29E-09	0.00%	0.00%	1.21E-05	7.21E-08	0.00%	0.00%
242Cm	3.74E-06	8.82E-09	0.00%	0.00%	2.61E-05	1.56E-07	0.00%	0.00%
243Cm	3.70E-06	8.72E-09	0.00%	0.00%	2.50E-05	1.49E-07	0.00%	0.00%
244Cm	1.29E-06	3.03E-09	0.00%	0.00%	8.82E-06	5.26E-08	0.00%	0.00%

Total for  
C-200  
series  
retrieval +  
activities

4.67E-01	4.14E-03	100.00%	100.00%	1.71E+00	1.02E-02	100.00%	100.00%
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Both abated and unabated doses include the unabated dose (no filtration) from  
the pit opening activities, equipment removal, and soil excavation activities

**ALARACT DEMONSTRATIONS USED FOR C-104 RETRIEVAL**  
**ALARACT 1**

**TANK FARM ALARACT DEMONSTRATION FOR RISER**  
**PREPARATION/OPENING**

**1. Description of Activity:**

*This ALARACT demonstration applies to risers that open directly into tanks containing high-level waste, such as waste storage tanks, catch tanks, double contained receiver tanks and IMUSTs. Other potentially, and known, contaminated risers in Tank Farm facilities shall be accessed using appropriate controls from the HNF-5183, Tank Farms Radiological Control Manual and the latest revision of the Containment Selection Guide, Appendix A, in HNF-IP-0842, Volume VII, Radiological Control, Section 16.7, latest revision.*

Risers may have screw caps, blind flanges, shield plugs, or equipment installed in them. Preparation may include the following:

Screw caps: A pre-work survey is completed of the riser and the area around the riser. Soil covering is installed around the riser. If the riser or screw cap is highly contaminated, a glove bag may be installed to control contamination spread. Slight contamination is wiped off the riser with damp rags.

Blind flanges: A pre-work survey is completed of the riser and the immediate work area around the riser, a glove bag may be used to contain the blind flange during removal. Slight contamination is removed with damp rags.

Shield plugs and other equipment to be removed from risers: Risers may have various types of equipment installed. The equipment will be installed and removed per ALARACT 13. To open the riser, it will be necessary to remove the equipment. A pre-work survey is completed of the riser, installed equipment, and the area around the riser. Soil covering is installed around the risers. If necessary, glove bags or sleeving may be used on smaller pieces of equipment to be removed. Larger items may require the need for a windbreak or containment tent.

When the riser is opened, Industrial Hygiene samples may be taken.

All containments used are in accordance with the *Containment Selection Guide, Appendix A*, found in *HNF-IP-0842, Volume VII, Radiological Control Section 16.7*, latest revision.

Soil covering may be of a material such as, plastic sheeting, rubber matting, foil backed paper, griflon, or any material that will prevent possible contamination from reaching the soil.

The riser will be closed after all riser activities are completed.

**2. Radiological Controls:**

- Follow ALARACT demonstration for "Packaging and Transportation of Waste" (ALARACT 4).
- Follow ALARACT demonstration for "Installation, Operation, and Removal of Equipment" (ALARACT 13).
- Pre-job survey is performed.
- Use approved *Containment Selection Guide, Appendix A*, from HNF-IP-0842, *Volume VII, Radiological Control, Section 16.7*, latest revision.
- Do not open risers if sustained winds are >25 mph. A local wind speed measurement device may be utilized in lieu of Hanford Meteorological Station readings, provided the reading is taken in an unobstructed location that is representative of the work area. Use of a local device and the measured wind speed readings taken from it must be documented in the JCS Work Record.
- Open riser time will be minimized.
- HPT coverage will be performed as specified in the Radiological Work Permit.

**3. Monitoring:**

- At a minimum, pre and post-job surveys (smears) shall be taken.
- Radiological monitoring shall be in accordance with the latest revision of HNF-5183, *Tank Farms Radiological Control Manual*.

**4. Records/Documentation:**

- Work Package
- Radiological Work Permit
- Radiological survey report(s)

**5. Emission Pathway:**

- Existing, active or passive point sources

**6. Facility Description:**

- All Tank Farm Facilities

## ALARACT 4

### **TANK FARM ALARACT DEMONSTRATION FOR PACKAGING AND TRANSPORTATION OF WASTE**

#### **1. Description of Activity:**

*Some materials become contaminated during work conducted within all Tank Farm facilities. Such contaminated materials, which are not released or otherwise controlled, are handled as radioactive waste. Radioactive waste generated from Tank Farms operations activities such as pit work, excavations, surveillances, housekeeping, maintenance and tank sampling, will be double-contained at a minimum. A radiological survey is conducted prior to storage or transportation of the outer-most container to verify that removable contamination meets the requirements under the Radiological Controls section.*

#### **2. Radiological Controls**

- Follow ALARACT demonstration for "Size Reduction of Waste Equipment for Disposal" (ALARACT 15).
- Radiological controls shall be in accordance with the latest revision of HNF-5183, *Tank Farms Radiological Control Manual*.

#### **3. Monitoring:**

- At a minimum, pre and post-job surveys (smears) shall be taken.
- Radiological monitoring shall be in accordance with the latest revision of HNF-5183, *Tank Farms Radiological Control Manual*.

#### **4. Records/Documentation:**

- Radiological survey report(s)
- Radiological work permit

#### **5. Emission Pathway:**

- Active or passive, point sources and fugitive sources

#### **6. Facility Description:**

- All Tank Farm facilities (except special nuclear material in 2718-E)

## ALARACT 5

### **TANK FARM ALARACT DEMONSTRATION FOR SOIL EXCAVATION (USING HAND TOOLS)**

#### **1. Description of Activity/Requirements:**

*Soil is routinely excavated in the Tank Farm facilities to support riser preparation, repair and maintenance activities, soil sampling, cleanup of contamination, removal of vegetation and biological hazards, and operational activities (laying conduit or cables for power). An initial survey is performed of the area to be excavated. Surveys are performed throughout the excavation to assure that worker safety and environmental protection is maintained. Once the excavation begins, water is used, as necessary, to prevent the spread of dust. To the extent practicable using hand held instrument field survey techniques, the clean soil is separated from the soil identified as contaminated. The contaminated soil has a fixative applied or is covered by plastic at the end of the shift, and as necessary, to stabilize the contaminated soil. The activities covered by this ALARACT demonstration do not include D&D. All radioactively contaminated soil excavation is conducted using hand tools.*

#### **2. Radiological Controls:**

- Follow ALARACT demonstration for "Packaging and Transportation of Waste." (ALARACT 4)
- HPT coverage will be performed as specified in the radiological work permit.
- A beta-gamma survey of the ground surface is required prior to excavation in Contamination Areas (CA's), High Contamination Areas (HCA's), Soil Contamination Areas (SCA's), and Underground Radioactive Material Areas (URMA's). An alpha survey may be required prior to excavation per the "Justification for Dual Survey Exemption in Tank Farm Facilities," HNF-3391.
- For excavation in CA's, HCA's, SCA's, and URMA's, if beta-gamma activity greater than 1000 dpm/probe area (5000 dpm/100cm<sup>2</sup>) is identified, alpha surveys will also be performed.
- Suppressants such as water, fixatives, covers, or windscreens will be used as necessary, including at the end of each shift or when sustained or predicted winds are >20mph.
- Excavation of radioactive material shall cease if sustained winds exceed 20 mph. A local wind-speed measurement device may be utilized in lieu of Hanford Meteorological Station readings, provided the reading is taken in an unobstructed location that is representative of the work area. Use of a local device and the measured wind-speed readings taken from it must be documented in the JCS Work Record.
- If the net contamination for the general area is greater than 200 dpm/probe area alpha or greater than 500,000 dpm/probe area beta-gamma, stop work, notify Environmental and Radcon, and implement the controls listed below.

**Once notifications have been made and the following controls implemented, excavation may continue:**

- Soil shall be wetted prior to excavation if not already damp.
- General area workplace air monitoring shall be performed during excavation activities.
- Excavation and contaminated soil piles will be covered with plastic, or fixative applied at the end of each shift, and/or as necessary to prevent airborne dust particles.
- Contaminated soil containing >500,000 dpm per probe area beta-gamma or >200 dpm/probe area alpha will be containerized or covered with clean fill if it is to be left for greater than 48 hours.

*If soil contamination exceeds 20 mrad/hr (open window reading), work will be stopped, Environmental and Radcon notified, and adequacy of controls will be reassessed. WDOH will be notified. Work may continue when approved by Environmental and Radcon with WDOH concurrence.*

If hot specks are detected during the radiological surveys, the specks will be removed and contained before the activity is allowed to continue unless located in the bottom of the trench after excavation has been completed. Specks found in the bottom of the completed trench may be covered with clean fill. A hot speck will be defined as a very small amount (i.e. less than or equal to 100 cm<sup>2</sup>) of contamination reading greater than or equal to 1,000,000 dpm/probe size beta-gamma and/or greater than or equal to 490 dpm/probe size alpha.

**3. Monitoring:**

- At a minimum, pre and post-job surveys shall be made
- Radiological monitoring shall be in accordance with the latest revision of HNF-5183, *Tank Farms Radiological Control Manual*

**4. Records/Documentation:**

- Work package
- Radiological work permit
- Radiological survey report(s)

**5. Emission Pathway:**

- Existing passive (fugitive/diffuse)

**6. Facility Description:**

- All Tank Farm facilities

## ALARACT 6

### TANK FARM ALARACT DEMONSTRATION FOR PIT ACCESS

*This ALARACT demonstration applies to all pits and filter pits which have the potential for exposing tank waste to the pit environment, except 241-ER-152, 241-S-151, 241-UX-154, 241-TX-154, 244-CR Vault DCRT, 244-A Lift Station DCRT, and 244-TX DCRT. Access to these pits must follow the existing Notice of Construction.*

*If the work activities are such that they can be performed without removal of pit covers, the controls listed in this ALARACT demonstration do not apply. Instead, the work shall be performed using appropriate controls from HNF-5183 "Tank Farms Radiological Control Manual" and the latest revision of the approved Radiological Containment Selection Guide matrix from HNF-IP-0842. Activities which may be conducted in this manner include pit videos/boroscopes, filling seal loops, valve handle change-out, pit wash-downs, fixative application, radiological surveys, remote operation of pit drains, leak detector troubleshooting or changeout, pit drain leak rate tests and removal or insertion of gas sampling lines. Any activity not included in this list must be approved by WDOH on a case-by-case basis.*

*Pits that do not have the potential for exposing tank waste to the pit environment do not require implementation of ALARACT controls for entry. Examples include flush pits, service pits, annulus pump pits and leak detection pits. These pits shall be accessed using appropriate controls from HNF-5183 "Tank Farms Radiological Control Manual" and the latest revision of the Containment Selection Guide, Appendix A, in HNF-IP-0842, Volume VII, Radiological Control, Section 16.7, latest revision.*

#### **1. Description of Activity/Requirements:**

**PREPARATION WORK:** A pre-job survey is performed on the exterior surface of the pit and the surrounding area. For pits that are partially or entirely below grade, a fall protection handrail is installed around the pit. The fall protection is draped in plastic sheeting that extends to the top of the pit. This establishes a splashguard around the pit. Before the pit covers are removed, an approved fixative may be applied inside the pit or the pit may be decontaminated as described below. These processes are generally performed through an access port. If there is no access port(s), the pit covers are raised and suspended, a radiological survey is performed, and/or a fixative may be applied inside the pit as described in Section 2, Radiological Control. The pit covers are removed.

**DECONTAMINATION:** Uniformly distributed removable contamination levels in the pit are decontaminated to less than 100,000 dpm/100 cm<sup>2</sup> beta/gamma and 2,000 dpm/100 cm<sup>2</sup> alpha by washing or an approved fixative is applied to pit surfaces. A fixative will matrix the contamination to ensure minimization of potential airborne contamination. If a high pressure (up to 3,000 psi) or low pressure (approximately 125 psi) whirly is installed, it is done through an opening (if one exists) in the pit

covers and the pit is washed down. The pit covers are lifted and contained if the removable level is greater than 50,000 dpm/100 cm<sup>2</sup> beta/gamma and 20 dpm/100 cm<sup>2</sup> alpha. The pit covers are then moved to a storage area. With the pit covers off, additional decontamination activities may include the use of chemicals, peel and strip paints, water, or manual scrub brushes. When decontamination activities are complete, other work may begin or a temporary cover is installed over the pit.

**CLOSURE:** After all activities in the pit are completed, the pit covers are reinstalled and the splashguard is removed.

## **2. Radiological Controls:**

- Follow ALARACT demonstration for "Riser Preparation/Opening" (ALARACT 1).
- Follow ALARACT demonstration for "Packaging and Transportation of Waste" (ALARACT 4).

Uniformly distributed removable contamination levels within the pit are decontaminated so that a swipe reads less than 100,000 dpm/100 cm<sup>2</sup> beta/gamma and 2,000 dpm/100 cm<sup>2</sup> alpha. Alternatively, a fixative may be applied. An approved fixative will be applied to pit surfaces if contamination levels exceed the limits stated above or as needed. Note: The fixative will matrix the contamination to ensure minimization of potential airborne contamination.

- Swipes will be taken to determine that splash guards are to be maintained below 50,000 dpm/100 cm<sup>2</sup> beta/gamma and 20 dpm/100 cm<sup>2</sup> alpha.
- Use a splashguard extending to the edge of the pit. Splashguard will be taped or sealed to the edge of the pit. If it is not feasible to seal the splashguard to the edge of the pit, an additional rail will be installed at the base of the handrail and the splashguard will be taped or sealed to that bottom rail. This rail will be as close as possible to the pit edge. A ground cover will be placed around the edge of the pit and extending under the bottom rail.
- Pit work will not be performed if sustained winds are >25 mph. A local wind speed measurement device may be utilized in lieu of Hanford Meteorological Station readings, provided the reading is taken in an unobstructed location that is representative of the work area. Use of a local device and the measured wind speed readings taken from it must be documented in the JCS Work Record.
- HPT coverage will be performed as specified in the Radiological Work Permit
- Use approved *Containment Selection Guide, Appendix A, in HNF-IP-0842, Volume VII, Radiological Control, Section 16.7, latest revision.*
- Active ventilation may be utilized in accordance with the PTRAEU NOC.

## **3. Monitoring:**

- At a minimum, pre and post-job surveys (smears) shall be taken.

- Radiological monitoring shall be in accordance with the latest revision of HNF-5183, *Tank Farms Radiological Control Manual*.

**4. Records/Documentation:**

- Work package
- Radiological work permit
- Radiological survey report(s)

**5. Emission Pathway:**

- Existing passive non-point sources

This ALARACT demonstration applies to all Tank Farm pits except 241-ER-152, 241-S-151, 241-UX-154, 241 TX-154, 244-CR Vault DCRT, 244-A Lift Station DCRT, and 244-TX DCRT.

## ALARACT 11

### TANK FARM ALARACT DEMONSTRATION FOR WASTE TRANSFERS

#### 1. Description of Activity/Requirements:

*Wastes are transferred to, from, and within actively ventilated tank farm storage facilities (i.e. double-shell tanks), chemical processing facilities, receiver vaults, mobile tanks, and evaporators. Wastes are also transferred from single-shell tanks during (and due to) salt well pumping. Transfers are made through a network of existing or to be installed above or below ground pipelines, and operating equipment. Transfers also utilize the existing network of controls or transfer structures (currently in use, or constructed under a Notice of Construction) such as diversion boxes, valve pits, double contained receiver tanks, and diverter stations. Jet, submersible, or transfer pumps are used to transfer waste at flow rates up to 300 gallons (1,132 liters) per minute. The pit covers are reinstalled on the pits before starting any waste transfer operation. Occasionally, water is added to a tank or transfer system to prevent or remove plugs. Other techniques to free blockages include chemical flushing, pressurization, temporary jumpers, hydraulic scouring, and the use of heat tracing. Flow rates and pressures used are determined by engineering evaluations. Flow into the sending/receiving tank is exhausted using a HEPA filtered vent.*

#### 2. Radiological Controls:

- Verify HEPA filtration on receiving tanks
- Follow ALARACT demonstration for "Riser Preparation/Opening" (ALARACT 1)
- Follow ALARACT demonstration for "Packaging and Transportation of Waste" (ALARACT 4)
- Follow ALARACT demonstration for "Pit Access" (ALARACT 6)
- Follow ALARACT demonstration for "Packaging and Transportation of Equipment and Vehicles" (ALARACT 12)
- Follow ALARACT demonstration for "Installation and Removal of Equipment from Tanks" (ALARACT 13)
- Follow ALARACT demonstration for "Pit Work" (ALARACT 14)

#### 3. Monitoring:

- Radiological monitoring shall be in accordance with the latest revision of HNF-5183, *Tank Farms Radiological Control Manual*
- Radiological surveys of the work area as required by the work package and/or procedure

- Post job survey(s)

**4. Records/Documentation:**

- Flow rate and pressure engineering evaluations
- Work package and/or Procedures
- Radiological work permit
- Radiological survey report(s)

**5. Emission Pathway:**

- Existing active Tank Farm passive point sources or fugitive non-point sources

**6. Facility Description:**

- All Tank Farm Facilities

## ALARACT 13

### **TANK FARM ALARACT DEMONSTRATION FOR INSTALLATION, OPERATION, AND REMOVAL OF TANK EQUIPMENT**

#### **1. Description of Activity/Requirements:**

*This ALARACT demonstration does not provide approval for the following activities: waste sampling, sluicing, lancing, operations of mixer pumps, and use of the LDUA. While operating under these activities, the applicable ALARACT demonstrations must be complied with.*

*A multitude of equipment may be installed, operated, and removed from tanks (actively and passively ventilated).*

*When installing and removing equipment from tanks, risers and pits are opened. ALARACT 1 (Riser Preparation/Opening) and ALARACT 6 (Pit Access) describe the activities necessary to prepare the risers and pits.*

*If water lancing is performed to assist in the installation of equipment, it will be done in accordance with ALARACT 10 (Water Lancing).*

Equipment is lowered into and removed from tanks either manually or remotely (e.g. using a crane). Once the equipment is installed, mating surfaces of the equipment and riser are sealed.

All equipment removed from tanks is contained using glovebags, sleeving, or other containment devices in accordance with the latest revision of the *Containment Selection Guide, Appendix A, in HNF-IP-0842, Volume VII, Radiological Control, Section 16.7*, latest revision.

The riser is closed under ALARACT 1 (Riser Preparation/Opening) and the pit is closed under ALARACT 6 (Pit Access) following installation or removal of equipment.

Waste is packaged and transported per ALARACT 4 (Packaging and Transportation of Waste). Equipment is packaged and transported per ALARACT 12 (Packaging and Transportation of Equipment and Vehicles).

#### **2. Radiological Controls:**

- Follow ALARACT demonstration for "Riser Preparation/Opening" (ALARACT 1)
- Follow ALARACT demonstration for "Packaging and Transportation of Waste" (ALARACT 4)

- Follow ALARACT demonstration for "Pit Access" (ALARACT 6)
- Follow ALARACT demonstration for "Water Lancing" (ALARACT 10)
- Follow ALARACT demonstration for "Packaging and Transportation of Equipment and Vehicles" (ALARACT 12)
- Follow ALARACT demonstration for "Size Reduction of Waste Equipment for Disposal" (ALARACT 15)
- Equipment is decontaminated or contained when removed from tanks
- Swipes will be taken to determine that the surface of the item or the outermost surface of the container are maintained  $<50,000$  dpm/100 cm<sup>2</sup> beta/gamma and/or  $<20$  dpm/100 cm<sup>2</sup> alpha
- HPT coverage will be performed as specified in the Radiological Work Permit
- Do not install or remove equipment if sustained winds are  $>25$  mph. A local wind speed measurement device may be utilized in lieu of Hanford Meteorological Station readings, provided the reading is taken in an unobstructed location that is representative of the work area. Use of a local device and the measured wind speed readings taken from it must be documented in the JCS Work Record.
- Use approved *Containment Selection Guide, Appendix A, in HNF-IP-0842, Volume VII, Radiological Control, Section 16.7*, latest revision

### 3. Monitoring:

- At a minimum, pre and post-job surveys (smears) shall be taken
- Radiological monitoring shall be in accordance with the latest revision of HNF-5183, *Tank Farms Radiological Control Manual*

### 4. Records/Documentation:

- Work package
- Radiological work permit
- Radiological survey report(s)

### 5. Emission Pathway:

- Active or passive, point sources and fugitive sources

### 6. Facility Description:

- All Tank Farm facilities

## ALARACT 14

### TANK FARM ALARACT DEMONSTRATION FOR PIT WORK

This ALARACT demonstration applies to all pits except 241-ER-152, 241-S-151, 241-UX-154, 241-TX-154, 244-CR Vault DCRT, 244-A Lift Station DCRT, and 244-TX DCRT.

#### **1. Description of Activity/Requirements:**

*When entering or exiting the pit, ALARACT 6 "Pit Access" must be complied with.*

*All equipment removed from the pit is decontaminated or contained. A temporary or permanent cover is placed over the pit if ever left unattended.*

*Installing pit leak detectors, unplugging drains, and housekeeping/waste removal activities are performed following the above description.*

*Specific activities performed in pits follows:*

*(NOTE: The "Pit Viper" may be used for any of the following activities as long as the appropriate controls, identified below, are implemented.)*

#### Jumper Work

Before any jumper work takes place, the affected lines are flushed (if possible) and an approved fixative is applied. The fixative will be applied in accordance with ALARACT 6 "Pit Access" and reapplied as necessary.

Swipes of the splash guard will be taken during the jumper work. If a used jumper is to be removed from the pit, it is drained and a fixative is applied. If removable contamination is greater than 50,000 dpm/100 cm<sup>2</sup> beta/gamma and/or 20 dpm/100 cm<sup>2</sup> alpha, the jumper will be contained and/or decontaminated.

If jumpers are cut, they are cut by hydraulic shears or a portable band saw within the pit. The pieces are contained before they are removed from the pit.

#### Pressure Testing Lines

A pressure test assembly is installed on the line to be tested in one pit. A blank with a drain is installed on the other end of the line in a separate pit. Temporary and/or permanent covers are placed over the pits during the pressure test.

## **2. Radiological Controls:**

- Follow ALARACT demonstration for "Riser Preparation/Opening" (ALARACT 1).
- Follow ALARACT demonstration for "Packaging and Transportation of Waste" (ALARACT 4).
- Follow ALARACT demonstration for "Pit Access" (ALARACT 6).
- Follow ALARACT demonstration for "Packaging and Transportation of Equipment and Vehicles" (ALARACT 12).
- A splashguard will extend to the edge of the pit where it is taped or sealed. If it is not feasible to seal the splashguard to the edge of the pit, an additional rail will be installed at the base of the handrail and the splashguard will be taped or sealed to that bottom rail. This rail will be as close as possible to the pit edge. A ground cover will be placed around the edge of the pit and extending under the bottom rail.
- Swipes will be taken to determine that splash guards are maintained below 50,000 dpm/100 cm<sup>2</sup> beta/gamma and 20 dpm/100 cm<sup>2</sup> alpha.
- Uniformly distributed removable contamination levels within the pit are decontaminated so that a swipe reads less than 100,000 dpm/100 cm<sup>2</sup> beta/gamma and 2,000 dpm/100 cm<sup>2</sup> alpha. An approved fixative will be applied to pit surfaces if contamination levels exceed the limits stated above or as needed. Note: The fixative will matrix the contamination to ensure minimization of potential airborne contamination.
- If a used jumper is to be removed from the pit, it is drained and a fixative is applied. If removable contamination is greater than 50,000 dpm/100 cm<sup>2</sup> beta/gamma and/or 20 dpm/100 cm<sup>2</sup> alpha, the jumper will be contained and/or decontaminated.
- A temporary or permanent cover is placed over the pit if the pit is ever left unattended
- Pit work will not be performed if sustained winds are >25 mph. A local wind speed measurement device may be utilized in lieu of Hanford Meteorological Station readings, provided the reading is taken in an unobstructed location that is representative of the work area. Use of a local device and the measured wind speed readings taken from it must be documented in the JCS Work Record.
- HPT coverage will be performed as specified in the Radiological Work Permit

## **3. Monitoring:**

- At a minimum, pre and post-job surveys (smears) shall be taken
- Radiological monitoring shall be in accordance with the latest revision of HNF-5183, *Tank Farms Radiological Control Manual*

**4. Records/Documentation:**

- Work package
- Radiological work permit
- Radiological survey report(s)

**5. Emission Pathway:**

- Existing passive non-point sources

**6. Locations:**

This ALARACT demonstration applies to all Tank Farm pits except 241-ER-152, 241-S-151, 241-UX-154, 241-TX-154, 244-CR Vault DCRT, 244-A Lift Station DCRT, and 244-TX DCRT.

## ALARACT 15

### **TANK FARM ALARACT DEMONSTRATION FOR SIZE REDUCTION OF WASTE EQUIPMENT FOR DISPOSAL**

#### **1. Description of Activity/Requirements:**

Size reducing, cutting or disassembling contaminated material and equipment is done for more economical waste packaging. Containment devices are employed as applicable per the Containment Selection Guide, Appendix A, in HNF-IP-0842, Volume VII, Radiological Control, Section 16.7, latest revision. The process is limited to mechanical cutting techniques such as low speed and high speed sawing, snipping, shearing, as well as hot work such as cutting torches. The process will also include bending, crimping, and compaction to preclude the need for cutting operations.

Examples of items cut up or disassembled for waste disposal during facility operations include long-length contaminated equipment (i.e. waste tank level instrumentation, thermocouple trees, specific gravity probes, observation ports, hose and piping), waste sampling equipment (i.e. drill strings or augers), pumps, compressors, and deactivated exhausters with associated ductwork. This includes replacement and disposal of flexible ventilation ductwork located upstream of HEPA filtration.

#### **2. Radiological Controls:**

- Follow ALARACT demonstration for "Packaging and Transportation of Waste" (ALARACT 4)
- Equipment with removable contamination will be contained per the *Containment Selection Guide, Appendix A, in HNF-IP 0842, Volume VII, Radiological Control, Section 16.7*, latest revision, or decontaminated
- HPT coverage as specified in the Radiological Work Permit

#### **3. Monitoring:**

- At a minimum, pre and post-job surveys (smears) shall be taken
- Radiological monitoring shall be in accordance with the latest revision of HNF-5183, *Tank Farms Radiological Control Manual*

#### **4. Records/Documentation:**

- Radiological work permit
- Radiological survey report(s)

**5. Emission Pathway:**

- Active or passive, point sources and fugitive sources

**6. Facility Description:**

- All Tank Farm Facilities

## ALARACT 16

### **TANK FARM ALARACT DEMONSTRATION FOR WORK ON POTENTIALLY CONTAMINATED VENTILATION SYSTEM COMPONENTS**

#### **1. Description of Activity/Requirements:**

*Scope will include work on potentially contaminated ventilation system components. This may include repair or replacement of ductwork, dampers, valves, recirculation fans, flexible boots, heaters, instrumentation, or other ventilation system components*

The process will be performed using mechanical techniques such as unbolting, drilling, snipping, shearing, cutting, abrading, or low and high speed sawing, as well as hot work such as cutting torches. Other activities may include installation of instrumentation, test ports, or sample ports. Containment devices are employed as applicable per the *Containment Selection Guide, Appendix A*, in HNF-IP-0842, Volume VII, Radiological Control, Section 16.7, latest revision.

If exhaust systems are replaced under the "replacement-in-kind" provisions of WAC 246-247 utilizing this ALARACT demonstration, then the abatement controls of the new system must be equivalent or better than those of the system that is replaced. The operational flow rate of the new system may not exceed that of the replaced system.

#### **2. Radiological Controls:**

- Follow ALARACT demonstration for "Packaging and Transportation of Waste" (ALARACT 4).
- Work with removable contamination will be contained per the latest revision of the *Containment Selection Guide, Appendix A*, in HNF-IP-0842, Volume VII, Radiological Control, Section 16.7, latest revision.
- HPT coverage as specified in the Radiological Work Permit

#### **3. Monitoring:**

- At a minimum, pre and post-job survey (smears) shall be taken
- Radiological monitoring shall be in accordance with the latest revision of HNF-5183, *Tank Farms Radiological Control Manual*

#### **4. Records/Documentation:**

- Radiological work permit
- Radiological survey report(s)

5. **Emission Pathway:**

- Active and passive, point sources and fugitive sources

6. **Tank Farm Facility Description:**

- All Tank Farm Facilities

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